Theor Soc (2017) 46:285–318
DOI 10.1007/s11186-017-9290-6

Metabolic rift or metabolic shift? dialectics, nature, and the world-historical method

Jason W. Moore[1]

Published online: 26 August 2017

Abstract In the flowering of Red-Green Thought over the past two decades, metabolic rift thinking is surely one of its most colorful varieties. The metabolic rift has captured the imagination of critical environmental scholars, becoming a shorthand for capitalism's troubled relations in the web of life. This article pursues an entwined critique and reconstruction: of metabolic rift thinking and the possibilities for a post-Cartesian perspective on historical change, the world-ecology conversation. Far from dismissing metabolic rift thinking, my intention is to affirm its dialectical core. At stake is not merely the mode of explanation within environmental sociology. The impasse of metabolic rift thinking is suggestive of wider problems across the environmental social sciences, now confronted by a double challenge. One of course is the widespread—and reasonable—sense of urgency to evolve modes of thought appropriate to an era of deepening biospheric instability. The second is the widely recognized—but inadequately internalized—understanding that humans are part of nature.

Keywords Environmental sociology · Marx · Political ecology · Social theory · World-ecology

> *Dialectics does not consider fixed artifacts, formations and objects, the entire complex of both the material world of things and that of ideas…, to be something original and autonomous. It does not accept them in their ready-made form, but subjects them to investigation in which the reified forms of the objective and the ideal worlds dissolve, [and] lose their fixed and natural character.*
>
> – Karel Kosík (1976, p. 6)

✉ Jason W. Moore
jasonwsmoore@gmail.com

[1] Department of Sociology, Binghamton University, PO Box 6000, Binghamton, NY 13902-6000, USA

> *To assume* one *basis for [human] life and a* different *basis for science is, as a matter of course, a lie.*
>
> – Karl Marx (1959, p. 98)

In the flowering of Red-Green Thought over the past two decades, metabolic rift thinking is surely one of its most colorful varieties.[1] The metabolic rift has captured the imagination of critical environmental scholars, becoming shorthand for capitalism's troubled relations in the web of life. This rift is generally understood in two overlapping senses. One is rift as separation. In this capitalism "continuously… separate[s] the social metabolism from the natural metabolism" (Clark and York 2005, p. 417). The second is rift as agent of disruption. Capitalism's "global metabolic rift" has "disrupted the 'eternal natural condition' of life itself" (Foster 2015 quoting Marx 1977, p. 637).

Rift thinking is frequently called a theory (Foster 1999, 2013; Moore 2011a, b). But the perspective offers few explicit theorizations of the capitalism/nature relation. Rift arguments form, rather, a family of conceptualizations that pivot on environmentalist tropes of separation and disruption. These have been productive. They have allowed for insightful investigations into capitalism as a way of organizing nature. That Rift analyses have rarely theorized capitalism's socio-ecological contradictions—beyond *marxisante* axioms that (rightly) say capitalism does terrible things to nature—accounts for a meaningful share of its flexibility and popularity. Metabolism has become a plastic category that can be molded to serve diverse analytical objectives. The Rift perspective's great accomplishment has been to join together—without synthesizing—the Green emphasis on modernity's environmental consequences and the Red focus on capitalism's political economy. As such, the metabolic rift represents the highest stage of "Green Arithmetic": Society plus Nature equals Crisis.

This is no small accomplishment. Led by John Bellamy Foster's lively pen and accessible prose, the Rift became a breakout hit in the decade after *Marx's Ecology* appeared (Foster 2000a). Foster and his colleagues popularized a broadly Marxist approach to environmental studies in American sociology. The metabolic rift was the right idea at the right time. The clarity of Foster's conceptualization—along with its relevance in an era of planetary crisis—gave the socio-metabolic re-reading of Marx considerable influence. It valorized a broadly critical political economy of global environmental change. It emphasized a historical perspective on environmental change. And it made clear that Marx's thinking on humanity's metabolism in the web of life offers indispensable tools in forging a revolutionary critique of capitalism, and for elaborating emancipatory vistas. These are important contributions.

That influence brought Marx's socio-ecological imagination to a wide audience. But success came at a price. Influenced by Foster's reading of social metabolism as a rift of "nature *and* society"—rather than society-*in*-nature—Marx's ecological thinking came to be narrowly understood, more or less cordoned off from the critique of political economy. "The" environment became just another—albeit a major—analytical object for Marxists. It did not compel a fundamental rethinking of how capital accumulation

[1] Key texts include Foster 1999, 2000a, b, 2009; Foster et al. 2010; Moore 2000a; Clark and York 2005.

works, how it booms, and how it develops through accumulation crises—the core concerns of Marxist political economy. No major scholar represents this divide better than Foster, for whom the unflinching defense of the theory of monopoly capital couples with an equally vigorous defense of an ecologically-informed historical materialism—with very little cross-fertilization.

"The environment" has been incorporated within Marxism's remit. Nature's incorporation, however, has occurred through addition rather than synthetic transformation. If environmentalist thought has long emphasized separation—Society and Nature—Marx's thinking pivots on relationality, movement, and differentiated unities. Nowhere is this clearer than when Marx accounts for the labor process as a triple transformation: of human nature, of "external nature," and of the relations of the mode of the production, the "life-process of society" (Marx 1977, p. 283; Marx 1967, I, pp. 84). Marx is emphatic on the point. Work is the activity of human nature internal to the web of life; labor-power is a "specifically harnessed natural force" (Marx 1973, p. 612).

This essay pursues an entwined critique and reconstruction: of metabolic rift thinking, and the possibilities for a post-Cartesian perspective on historical change, embodied in the world-ecology conversation (Moore 2015a). Far from dismissing metabolic rift thinking, my intention is to affirm its dialectical core. At stake is not merely the mode of explanation within environmental sociology. The impasse of metabolic rift thinking is suggestive of wider problems across the environmental social sciences, now confronted by a double challenge. One of course is the widespread—and reasonable—sense of urgency to evolve modes of thought appropriate to an era of deepening biospheric instability. The second is the widely recognized—but inadequately internalized—understanding that humans are part of nature (Moore 2015a).

To this end, I foreground two pivotal questions, implicit in—but not engaged by—Rift arguments. One major question turns on Nature/Society dualism and the problem of post-Cartesian thought (e.g., Bennett 2009; Braun and Castree 1998; Cronon 1995; Haraway 1991, 2016; Harvey 1993; Latour 1993; Williams 1980). Is agriculture—central to the first wave of Rift analyses—a combination of social and ecological elements? If so, how does one draw that line in a non-arbitrary fashion? Or is it more adequately considered as a relational configuration, of how humans have mixed their "labor with the earth" (Williams 1980, p. 83)? Rift arguments have sidestepped that question. In Rift models, the relations between basic units—Nature/Society and their specifications—may shift, but the constitution of these units remains outside their interaction. We might call this procedure *dualist practicality*. In their embrace of Green Arithmetic—Nature plus Society—Rift analysts are "at least indirectly, and in effect, 'accepting' the [intellectual] framework" of modernity, even as they seek to challenge it (Mills 1959, p. 78).

Green Arithmetic rules out a view of class, capital, and empire as co-produced in the web of life. More problematic still, Foster explicitly *defends* an approach that begins with Nature/Society abstractions, a procedure that short-circuits relational approaches to human history in the web of life (2013; e.g., Moore 2015a; Haraway 2016). There are two meta-theoretical issues here. One is a debate over human sociality and its identity with Society. Human sociality is fundamentally a multi-species affair: try narrating human history abstracted from dogs, rice, pigs, or maize. The second is a debate on whether or not one may abstract geographical relations, configurations, and conditions from conceptualizations of historical change. Can one dispense with

geography in conceptualizing capitalism's histories, or are such geographies an ontological condition of historical change? Dualist practicality affirms the identity of human sociality with Society, and the excision of geography from concepts of historical change. For these reasons, such practicality undermines research programs that might illuminate the mutual constitution of human organization within the web of life.

A second set of questions unfolds from the first. If humans are part of the web of life – and if the web of life permeates every nook and cranny of human relations – what does that mean for the history of the modern world, and for its *longue durée* political economy? These are the questions taken up by the world-ecology perspective. While both history and political economy are invoked by Rift analysts, they have made little headway in historical research, at times coming perilously close to structural-functionalism, and have shown little interest in rethinking the theory of capital accumulation. These two issues—of a broadly conceived environmental history and Red-Green political economy—are posed directly by the world-ecology conversation, through which capitalism is understood as an evolving totality of capital, power, and nature (Moore 2015a; Patel and Moore 2017; Altvater 2016; Bolthouse 2014; Camba 2015; Campbell 2016; Cox 2015; Deckard, 2016; Dixon 2015; El Khoury 2015; Frame 2016; Gill 2016; Hartley 2016; Jakes, 2016; Marley 2016; McBrien 2016; Niblett and Campbell 2016; Oloff 2016; Parenti 2015; Taylor 2015; Weis 2013).

Just how one goes about moving from the dualism of Humanity *and* Nature to the dialectics of humanity-*in*-nature has been a vexing, and largely unresolved, problem for Green Thought and critical theory since the 1970s. In what follows, I pursue the dialectical synthesis suggested—but never realized—by Foster and the Rift perspective. I unfold the outlines of this synthesis through a reconstruction of metabolism as a means to unify, methodologically, the differentiated flows of capital, power, and life in historical capitalism. If metabolism is not an exchange between quasi-independent objects (Nature/Society) but rather a process of life-making within the web of life new possibilities emerge. A conception of a *singular*, internally diverse, historically variant and geographically uneven, metabolism of humanity-in-nature might allow us to chart a course beyond dualism.

Metabolisms, Marxisms, & other mindfields

The turbulence of the twenty-first century poses a serious analytical challenge: How does capitalism develop *through* nature and not just act upon it? Try drawing a line around the "social" and "environmental" moments of financialization, global warming, resurgent fundamentalisms, the rise of China—and much beyond. The exercise quickly ends in futility. Not because these processes are "too complex," but because the conventional reckoning of Nature/Society yields the wrong questions—and the wrong answers. Such questions and answers are premised on the idea of humanity's practical separation from the web of life.

But is not the inverse more plausible?

If "the truth is the whole" (Hegel), then the story of specific totalities—of financialization or climate change or even historical capitalism—cannot be adduced by aggregating environmental and social parts. For the "social" moment of these processes is essentially co-produced and co-productive; it is a product of nature as a

whole. Far from blurring the specificity of "social" relations, such an approach enhances our capacity to grasp their specificity. Consider, for instance, the formation of new class, racial, and gender orders in the centuries after 1492. Could we really explain the emergence of modern racism while bracketing the conquest and depopulation of the Americas? Or while abstracting the sugar planting frontier's ferocious record of biogeographical transformation? Or not considering the hardening of the Human/Nature divide in which most humans—women, peoples of color, and many others—were expelled from Humanity with an uppercase 'H'? The question of human sociality (difference, conflict, and cooperation) remains at the center of such an alternative, but is now situated within lively and unruly assemblages that enfold and unfold the organic and inorganic, the human and the extra-human, the symbolic and the material (Birch and Cobb 1981; Haraway 2016).

Situating human sociality within historical webs of power, capital, and nature significantly shifts our explanatory problem. *Out* goes the problem of how humans created Society separate from Nature. *In* comes a new set of questions, turning on humanity's patterns of difference, conflict, and cooperation within the web of life. Financialization, in this light, is not a social process with environmental and social "consequences"—consequences that subsequently issue social *and* environmental "limits" and which might be remedied through social *and* environmental "justice." Financialization is, rather, a *bundle* of human and extra-human natures. Its claims on future wealth involve claims on future capacities of human *and extra-human* work, and its transmutation into capital.

The contradictions—the "laws of motion"—of such bundled processes are not rooted in an abstract Society (in general) pressing against an equally abstract Nature. They are, rather, rooted in the mosaic of modernity's "double internality" (Moore 2015a, p. 3)—that is, in the ways that power and re/production are specifically bundled within a web of life that makes humans and that humans make. (Hint: when humans interact with other humans, we are—as any careworker and every parent can tell you—dealing with unruly natures that defy the boundary Nature/Society.)

Put simply, humans are a part of nature. The totality of nature is immanent in every human thought, organization, and movement. The statement is hardly controversial. Most environmental studies scholars would agree… at least in principle. It feels good to characterize "human society" as "*internal to* and *dependent upon* [the] larger earthly metabolism" (Foster 2013, p. 8). And for many scholars of global change, such feel-good statements are the end of the line. It is decidedly less comfortable—and considerably more daunting—to rethink our methodological frames, theoretical propositions, and narrative strategies in this light. If not just humans, but human *organizations*, are products and producers of extra-human nature, a fundamental rethinking of storytelling, concept formation, and methodological orientation follows.

That such rethinking has made little headway until recently—with the explosion of actor-network, assemblage, world-ecological, and multi-species perspectives—is hardly surprising. For to move beyond Green Arithmetic in an analytical-empirical sense is to challenge the very basis of the social sciences and their governing conceit: that human activity is, for practical analytical purposes, "exempt" from the dynamics of the web of life. In the logic of "human exemptionalism" (Dunlap and Catton 1979; also Haraway 2008; Moore 2015a, b), relations between humans are ontologically

independent of nature. Human exemptionalism allows one to speak of modernity as a set of social relations that act upon, rather than develop through, the web of life. It allows one to assume that history, at manifold temporal and spatial resolutions, unfolds as a kind of ping-pong between "natural forces" and "human agency."

Foster's groundbreaking contribution was to use metabolism as a means of putting work—the work of humans and the work of nature—at the center of the question of nature, and therefore the history of capitalism. His formulation of metabolic rift marked a kind of halfway house: between Cartesian and post-Cartesian social science. Within the context of American sociology, Foster consciously aimed at transcending the limits of human exemptionalism and establishing a research program grounded in classical social theory, Marxism above all (1999). The conjuncture was fruitful. The rise of environmental sociology in the 1970s had not changed the discipline. Marxism, too, had yet to find its groove around ecological questions. By the late 1990s, however, the conditions had ripened for the rise of metabolism as a "conceptual star" (Fischer-Kowalksi 1997). A vigorous research program was established.

This conceptual star shaped a significant current within the environmental humanities at the dawn of the twenty-first century. In distinct registers, metabolism strongly influenced both Fischer-Kowalski's neo-Malthusian "socio-metabolic" school and *Marxisante* approaches to global environmental change (Fischer-Kowalski and Haberl 1998; Foster 1999). Metabolism appeared to offer the possibility of fording the "Great Divide" of Nature and Society (Goldman and Schurman 2000).

Foster's early formulation of metabolism suggested how we might realize that possibility (1999, 2000a). In emphasizing work, nature, and capital, Foster appeared to propose a new method of bounding human and extra-human natures. Human-initiated processes and relations could be situated within their internalization of particular extra-human natures, and within nature as a whole. At the same time, the biosphere could be understood as internalizing elements of human-initiated process—obviously an asymmetrical relation. Such a method would take seriously a messy process of co-production, one that could move beyond re-branding Society as "human nature" and Nature as "extra-human nature." In such a reckoning, the perils of environmental determinism and social reductionism would be transcended. Human "society" could be understood as simultaneously a producer and product of the web of life, unevenly co-produced and symbolically enabled. In so doing, the specific forms of human sociality could be distinguished and analyzed in much more complex and nuanced ways relative to those blunt instruments, Nature/Society. Metabolism, in this potential synthesis, would bridge the Great Divide.

And yet, despite its appeal, such a synthesis never occurred. The bridge was never built. Foster's elaboration of metabolism and materialism quickly foreclosed the very possibility of synthesis that it suggested. Marx's "interdependent process of social metabolism" was forced into a dualist frame: the "metabolism of nature *and* society" (Marx 1981, p. 949; Foster 2000a: ch. 6, emphasis added). At the same time, Foster encouraged a theoretical rift between historical materialism and critical political economy, underscored by a reluctance to develop the socio-ecological possibilities of Marx's theory of value. The dualism of Society (humans without nature) and Nature (ecologies without humans) was not transcended.

Criticizing Western Marxism for banishing nature from dialectics, Foster established a new Red-Green canon and drew a new cognitive map for ecological Marxism. The

new Red-Green canon was notable not only for whom it included—but also for whom it left out. Including such figures as Richard Levins, Richard Lewontin, Stephen J. Gould, and Barry Commoner, Foster excised many other leading critical thinkers of the new environmental social sciences in the long 1970s: David Harvey, Neil Smith, Michael Watts, Robert M. Young, and Carolyn Merchant, just for starters.[2] Geographers have been unwelcome in Foster's canon, and especially those closely associated with David Harvey (see Foster and Clark 2016; Foster 2016a, b).[3] The exclusion of geographers—Foster cannot find a single geographer to credit with moving beyond "first-stage eco-socialism" (Burkett and Foster 2016, pp. 3–4)—is important in its own right. (Nor does Foster's classic 1999 article make reference to a (then) quarter-century of Marxist-influenced political ecology.)

This disciplinary exclusion had two major effects. First, Foster's expulsion of geographers from his version of ecological Marxism is tightly related to his procedure of abstraction. For Foster, Society (and capitalism) can be conceptualized abstracted from geographical relations and conditions. Just as no historian would accept ahistorical conceptions of social change—say, crude versions of modernization or demographic transition theory—no geographer would accept a conception of Society abstracted from geography. Secondly, the refusal of geographers to accept ungeographical conceptions of Nature/Society relations has led to a broad skepticism regarding dualism (see especially Watts 2005; e.g., Harvey 1995; Heynen et al. 2007; Peet et al. 2011; Braun and Castree 1998). Foster's reluctance to engage geographical knowledges combines with a disciplinary insularity that has effectively removed him from meaningful conversations with geographers and other scholars in the humanities and social sciences who have made the "spatial turn" (e.g., Warf and Arias 2008). Among the intellectual consequences is Foster's unwillingness to discern social constructionist from materialist interpretations that differ from Rift interpretations. The argument for historical-geographical materialism, for instance, privileges the relationality of humanity-in-nature (and nature-in-humanity) in which material and cultural transformations are entwined—without succumbing to idealism (Smith 1984; Harvey 1995; Braun and Castree 1998; Moore 2015a). And yet, for Foster, all deviations from his interpretation of Marx are idealist and constructionist. Critics of the Rift are less-than-truly Marxist (e.g., Foster 2013, 2016a, b; Foster and Clark 2016). The evaluative process is black and white, either/or—interpretative differences are cast into the cauldron of Cartesian rationality, boiling down all difference into binary categories.

Foster's Red-Green canon has evolved alongside a new cognitive map of Nature and Society. Thanks to Foster and others, Nature earned a place within Marxism—and even beyond. On offer, however, was a narrow interpretation of Marx's thinking about the web

[2] Representative texts include Harvey (1974), Merchant (1980), Young (1979), Watts (1983), and Smith (1984).

[3] Foster (2013a, p. 9) presents Harvey as arguing for nature as an "outer boundary" (2013, p. 9)—a position that distorts Harvey's actual position. Harvey holds to a strongly relational view of socio-ecological relations in which "all ecological projects (and arguments) are simultaneously political-economic projects (and arguments) and vice versa" (1993, p. 25; also 1995). An analogous misreading is found in Foster's appropriation of my conception of epochal crisis (Moore, 2011a, b), which he describes as the "convergence of economic and ecological contradictions" (2013b, p. 1). These appropriations indicate Foster's unwillingness to engage the relational critique on its own terms.

of life (Moore 2015a). Foster saw nature as Nature, with an emphatically uppercase 'N.' Dualism had won the day. Rift as metaphor of separation, premised on material flows *between* Nature and Society, triumphed. The accomplishment was mighty, but so was the cost. Pushed to the side was a vision of metabolism as a means of unifying humans within nature, unfolding through combined and uneven metabolisms of power, wealth, and nature. The dualist conception of metabolism and its rifts influenced a decade and more of critical environmental studies, especially within environmental sociology.

This was perhaps not a significant problem for the first decade of the twenty-first century. New interpretations and empirical analyses poured forth. By 2010, however, it began to look as if Rift arguments had explained about as much as they could within Green Arithmetic's constraints (e.g., Foster et al. 2010). Rift analysts had largely completed the work of mapping capitalism's environmental problems—but the additive character of that project constrained its ability to explain how capitalism develops through a co-productive dynamic, one in which it is both producer and product of the web of life.

The metabolic rift perspective is not alone in this—Green Thought's signal accomplishment, from the 1970s, was to fill in and flesh out the blank spots in the human exemptionalist cognitive map. Like Green Thought as a whole, Rift arguments were caught in a powerful contradiction: a "double yes" (Moore 2015a). Are humans part of nature? Yes. Can we analyze human organizations as if they are independent of nature? Yes. Metabolism-centered studies, like much of critical environmental studies, face an unresolved contradiction: between a philosophical-discursive embrace of a relational ontology (humanity-*in*-nature) and a practical-analytical acceptance of Nature/Society dualism (dualist practicality). It has been one thing to affirm and explore the ontological and epistemological questions (e.g., Bennett 2009).[4] But how does one move from seeing human organization as part of nature towards an effective—and *practicable*—analytical program?

Metabolisms unfolding: chaotic conceptions and the epistemic rift

That question is ruled out by the very terms of the metabolic rift. Emphasizing disruption and separation, rather than reconfiguration and unity, the metabolic rift has come to signify "a disruption in the exchange between social systems and natural systems" (York 2010; also Foster 2013, p. 8). Social systems are separate from natural systems. Social systems *disrupt* natural systems. As capitalism develops, the disruption of nature widens and escalates, leading to "planetary crisis." Catastrophe ensues.

It all makes a certain amount of sense. But is it *good* sense? Is nature really best considered as external to capitalism? Or are capitalism *and its limits* co-produced through shifting configurations of human and extra-human nature?

[4] The critique of nature/society dualism is vast. Classic statements include Smith (1984); Plumwood (1993); Braun and Castree (1998). Descartes is simply one of several possible names for the kind of dualism that emerged with the rise of capitalism in the early modern era (Moore 2015a).

Among Nature/Society dualism's essential features is the tendency to circumscribe truth-claims by drawing hard-and-fast lines between what is Social and what is Natural.[5] *Here* is a rift: an *epistemic* rift.[6] At its core is a series of violent abstractions implicated in the creation and reproduction of two separate epistemic domains: Nature and Society (again in the uppercase). The abstractions are "violent" because they remove essential relations from each node in the interests of narrative and theoretical coherence (Sayer 1987). Dialectical abstractions, in contrast, begin with historical movement and strategic historical relations—something conspicuously absent from Nature/Society.

The procedure of abstraction is central to Marx's method, with implications that go far beyond philosophy (Ollman 2003). How we abstract reality into semi-fixed categories shapes our interpretation; analytics in turn shape politics and policy. This is why Foster's defense of Nature/Society as appropriate abstractions—strikingly at odds with Marx's method—is so curious (Foster 2013). Nature/Society are undialectical abstractions. They are no more dialectical than, say, "the market" and "industry," or "population" and "environment." At best, these are chaotic conceptions, as Marx would say (1973, p. 100).

Such chaotic conceptions are violent in Sayer's sense of the term—but also in a more practical sense. The language of Nature and Society is hardly value-neutral. Environmental sociology, in particular, has yet to experience its Bourdieu-ian moment, "reflexively" grasping the degree to which Nature/Society embody arbitrary yet patterned relations of power (Bourdieu and Wacquant 1992). While a distinction between humans and the rest of nature antedates capitalism by millennia (Arnold 1996), the elevation of Nature/Society to a civilizational organizing principle did not occur until the "long" sixteenth century (Braudel 1953; Wallerstein 1974; Moore 2016a). This is no mere quibble over terms. Cartesian dualism as a system of thought—*and as a conceptual vocabulary*—has been a quite palpable force in the making of the modern world. Nature and Society have been *real abstractions*—abstractions with operative force in the material world (Sohn-Rethel 1978; Toscano 2016). These and cognate terms, clustered in early modern Europe around "civility" and "barbarism" or "savagery," implicated a new ways of thinking … and a new civilizational praxis: Cheap Nature.

The birth of these real abstractions, Nature and Society, was consolidated in early capitalism (Merchant 1980; Moore 2015a). In the centuries after 1450, capital, science, and empire enacted a series of socio-ecological and symbolic revolutions aimed at the creation of an "external" nature as a source of cheap inputs (Moore 2014, 2015a). *What is crucial to understand is that "Nature" in the rise of capitalism came to include the vast majority of humans within its geographical reach.*

Nature—again our uppercase "N"—was fundamental to capitalism from the beginning. The Columbian rupture of 1492 marked not only the "discovery" of the Americas, but the "discovery of Mankind"—and with it, Nature (Albuafia 2008; Mumford 1934). For the Columbian conquests were not merely exterminist and plundering; their epochal significance derives also from ambitious imperial projects to map and catalogue productive natures of every kind (Blechmar et al. 2009). The project proceeded through the assumption that Nature included indigenous peoples.

[5] Harvey offers the clearest exposition of this critique (1993).

[6] The term is indebted to Schneider and McMichael (2010), whose formulation is, however, distinct from epistemic rift as epistemological dualism.

The overseas empires, beginning with the Iberian powers, "collected, harnessed, and ordered (natural) things as they tried to construct and control (knowledge about) the natural world." These "practices included the collecting of humans, that is (savage) bodies, as fungible commodities to be classified and exploited" (Modest 2012, p. 86).

The newly discovered Mankind was of a piece with early modernity's epistemological and ontological revolution, creating Nature as external to civilization and subordinating it to new "measures of reality"—above all the primacy of visual knowledges embodied in the cartographic gaze and new procedures of quantification (Crosby 1997; Mumford 1934). At best, the paired "discovery" of Mankind and Nature was less anthropocentric than it was Manthropocentric—to borrow Raworth's apt turn of phrase (2014; see Federici 2004; Merchant 1980). At its core was an always-contested boundary between which humans counted as Human and which would be forcibly resettled into the zone of Nature. The conquest of the Americas and the paired "discoveries" of Nature and Humanity/Society were moments of a singular movement.

Colonialism, ethnic cleansing, and the emergence of Nature as a violent and real abstraction co-evolved from the very beginning. During the protracted conquest of the Canaries, Portugal's King Duarte put the issue starkly (1436): Canarians are "nearly wild men … living in the country like animals" (quoted in Hulme 1994, p. 187). The same discourse characterized English rule in Ireland a century later (Rai 1993). Ethnic cleansing—typically in the name of "taking away their inhumanity" (Sued-Badillo 1992)—was the order of the day in the three great military campaigns culminating in the Columbian invasions. The final waves of conquest of the Canaries (1478–1490s) and Granada (1482–1492)—which cash-strapped Castile and Aragon financed largely through slaving—were key moments in an emergent capitalism installing and reproducing a Humanity/Nature binary through an equally emergent racialized and gendered order (Nader 2002; Kicza 1992).

The earliest moments of conquest were effected through a radical inversion of land/labor arrangements—underscored by the overnight reinvention of the *encomienda*, from a medieval land grant and to a precociously modern labor grant. Indigenous peoples became *de facto* slaves, while the booming sugar plantation complex pioneered modern slavery *de jure*—tentatively at first in Madeira, and reaching critical mass in Brazil after 1600. An African slave was part of Nature—not Society—in the new order. Here Patterson's characterization of modern slavery as "social death" receives a post-Cartesian twist (1982). Most *human* work was not labor-power and therefore most humans within capital's gravitational pull were not, or not really, Humans. This meant that the realm of Nature encompassed virtually all peoples of color, most women, and most people with white skin living in semi-colonial regions (e.g., Ireland, Poland, etc.) (von Werlhof, 1988; Rai 1993). Not for nothing did Castilians refer to indigenous Andeans in the sixteenth century as *naturales* (Stavig 2000). The problem with Nature and Society is not merely discursive—they are real abstractions with real force in the modern world we now inhabit.

Primitive accumulation therefore yielded not only bourgeois and proletarian, but Society and Nature. This is not a rhetorical flourish. The binary tendency

of modern class formation and the dualism of Society and Nature reinforced each other in the rise of capitalism (Moore 2015a, 2016b, 2017a, b).

We can see this close relationship with the evolution of the word Society. Society begins to assume its modern English usage—as national collectivity—from the mid-sixteenth century (Williams 1983, p. 292; also OED 2016). The timing is significant. At precisely this point, following Kett's Rebellion (1549), the tide of agrarian class struggle shifted decisively in favor of the gentry (Wood 2007). By 1700, England's landlords held two-thirds of arable land (Thompson 1966). Nor was it coincident that this period saw, from 1541, the intensification of English colonial rule in Ireland (Ohlmeyer 2016). Through all this, the Irish (and later North America's indigenous peoples), the poor, most women, and many others came to be viewed as "savages" of one sort of another—a view that justified all manner of bloody expropriations (Leerssen 1995; Moore 2016b). Here we begin to see modernity's emergent epistemic rift practically bound to capitalism as ontological formation—as a world-ecology of power, capital, and nature. The cheap nature strategy had become pivotal to the audacious restructuring of human relations along modern—and powerfully dualist—lines of class, race, and gender.[7]

Modernity's epistemic rift is premised on the creation of two idealized and independent objects of investigation: Nature/Society. The binary is so resilient because its underlying ontology is mechanical, which corresponds remarkably well with capitalist rationality via the quantism of capital in its monetary and productivist forms (currency units, units of labor-power, etc.). In the dualist cognitive map, environmental "factors" are easily tacked onto the analysis of social processes—just what has occurred through Marxist Green Arithmetic. Phrases like "nature-society dialectic" (e.g., Foster 2013) confuse relations for dialectics, and general abstractions and empirical patterns (e.g., Nature/Society) for the "developing tendencies of history" (Lukács 1971, p. 184). Nature and Society can only be a dialectic—as opposed to a relation—through a specification of their laws of motion. Capital/labor is a dialectical relation for this very reason: it is asymmetrical and grounded in a historical-geographical movement of transcendence. At once producer and product of the town/country antagonism (its geographical moment), the capital/labor dialectic entails the undoing of an originary asymmetry in favor of a new synthesis: "the expropriators are expropriated" (Marx 1977, p. 929). Rift arguments, however, deploy Nature/Society very differently, as basic units rather than interpenetrating relations (Levins and Lewontin 1985). Nature as a general abstraction—like population or production in general (Marx 1973)—dominates.

As if to move from the frying pan into the fire, Rift analysts dismiss as idealist efforts to historicize the capitalism-nature relation (e.g., through integrating accounts of science and culture in successively dominant understandings of the web of life) (e.g., Foster and Clark 2016). The result is a twofold conception of history shaped by a declensionist Fall from Eden and the inexorable drive towards catastrophe in which capital accumulation will proceed until "the last tree has been cut" (Foster 2009, p. 206). No one disputes the reality of socio-ecological disaster, planetary change, and limits—notwithstanding Foster's insistence to the contrary (2016, 2017). In dispute is, rather, how we think planetary crisis, and the relations of nature as a whole and capitalism as a whole. In this respect, Rift analyses have resisted the tendency of

[7] My concept of ontological formation draws on James's groundbreaking work (2015).

dialectical praxis to dissolve its analytical objects, and to create new categories suitable to comprehending the historically successive interpenetrations of humans with the rest of nature.

The metabolic rift: results and prospects

Foster began with a conception of capitalism that reached beyond Nature/Society. Precociously, Foster argued that environmentalist politics could go nowhere without grasping environmental problems as class problems (1993). He argued for an "absolute general law of environmental degradation," rendering the combined and uneven movements of pollution and depletion immanent to capital accumulation (1992). Most significantly, Foster saw environment-making as fundamental to capitalist development. In *The Vulnerable Planet*, he perceptively observes an epochal shift in humanity's relation to the rest of nature during the long sixteenth century—later amplified by the Industrial Revolution—and that eras of capitalism were bound up with new ways of organizing nature (1994).

Foster first formulated the metabolic rift in a now-classic article published in 1999. Three dimensions of capitalism's rift were central. First, there is a "rift between human production and its natural conditions" (Foster 1999, p. 370). Second, there is a "material estrangement [alienation] of human beings in capitalist society from the natural conditions of their existence" (ibid., p. 383). And third, this rift finds its decisive geographical expression in the "antagonistic division between town and country" (ibid., p. 384). Foster initially used the *rift* in metabolic rift to signify the channeling of food and resources produced in agrarian zones into urban and industrial spaces. Although metabolic *rift* today is widely understood as a metaphor of separation, the original argument seemed to suggest something different: rift as *reconfiguration and shift*.

That initial formulation was quickly complemented by *Marx's Ecology* (Foster 2000a), a landmark in the development of Red-Green Thought. *Marx's Ecology* advances a simple and powerful model. Food and resources, produced in the countryside, are consumed in the cities. Food eaten in the cities is not returned—as waste—to the fields; forests are claimed for fuelwood and construction with no biophysical recycling; minerals are extracted with no possibility for their renewal. These reconfigurations of nutrient, mineral, and energy flows were pivotal—not auxiliary—to the ongoing separation of the direct producers from the means of production (primitive accumulation). Thus did the rise of capitalism imply a new geography of wealth and power in which metabolism was immanent to relations of class, state, and value (Foster 2000a, pp. 170–173). In Foster's reading, any attempt to separate the history of class, state, and production from metabolic flows was irremediably partial.

This metabolic shift was, moreover, implicated in a new crystallization of wealth: value as abstract social labor (Foster 2000a, pp. 133, 167–167, 285n). Here, Foster follows Marx in seeing the rise of capitalism as tightly linked to an epochal shift in the town-country division of labor (Marx and Engels 1970). This is the "urbanisation of the countryside": the tendential expansion of bourgeois property relations into agrarian spaces, whose "urbanisation" is the condition for the generalization of commodity production and exchange (Marx 1973, pp. 479, 459; also 1977, Part 8).[8] Crucially, Foster conceived of capitalism's

[8] This socio-ecological dimension of urbanization is effectively pursued by Neil Brenner and his colleagues (2013).

metabolism as an open-flow system, vitally dependent upon frontier expansion—in this instance the cascading movement of primitive accumulation, subsequently encompassing the colonial world, as in the nineteenth-century Anglo-Peruvian guano trade and America's antebellum agricultural frontiers (2000a, pp. 149–154).

This conception of metabolic rift compelled a radical rethinking of the history of capitalism, as I argued at the time (Moore 2000a, 2000b). Foster's principal historical claim turned on agro-urban nutrient cycling. This struck me as undeniably pivotal, offering a means of "ecologizing" the agricultural revolution models on both sides of the transition debate (e.g., Brenner 1976; Wallerstein 1974; see Moore 2003a, 2003b). Although Foster's primary historical example of the metabolic rift focused on nineteenth-century developments—England's "second" agricultural revolution—he understood that capitalism emerged through an earlier succession of metabolic rifts.[9]

Those earlier metabolic revolutions could be seen at work in the long sixteenth century (Moore 2010a, 2010b). Although urban-industrial wastes were sometimes recycled in early capitalism—the seventeenth-century Dutch Republic is a good example—we can see the metabolic rift at work as capitalists (Dutch especially) extracted nutrients from countrysides near and far, and concentrated pollution in the cities (de Vries and van der Woude 1997, pp. 202–204). Even before the Industrial Revolution, air pollution was a problem in some European cities: Amsterdam's city council banned the use of coal in sugar refining in 1614 (Braudel 1982, p. 193). Meanwhile, Polish agriculture, which fed Amsterdam, was re-shaped into an agro-export zone under Dutch hegemony. Not surprisingly, Polish agriculture experienced sharply declining agricultural productivity by the mid-seventeenth century (Moore 2010b). As England become Europe's breadbasket after 1700, we see a similar dynamic at play—English agriculture was exhausted by 1760 and grain exports ceased (Moore 2016b). This relation of nutrient exhaustion and urbanization is Foster's "absolute general law of environmental degradation" (1992), whose contradictions issue "successive, historical breaks in nutrient cycling" (1999, p. 399; also Foster and Magdoff 1998; Moore 2000a).

Foster, in this early formulation, recognizes a metabolic rift "in general" and a succession of metabolic rifts specific to capitalism's uneven geographies. This is a move familiar to students of Marx's method. One moves from general to successively more determinate (specific) abstractions (Murray 1988; Sayer 1987). Nature in general, population in general, metabolism in general—these are no more adequate for historical explanation than the concept of "production in general" (Marx 1973, pp. 85–86). General abstractions steadily yield to abstractions grounded in capitalism's historical relations. One thinks, for instance, of the various conceptions of production mobilized to interpret neoliberal globalization: flexible accumulation, lean production, just-in-time production, and so forth. Contrast this with the Rift conceptions of nature, in the neoliberal era and well before: nature in general.

The metabolic rift perspective has largely ignored this element of Marx's method. To be sure, Rift analysts frequently invoke history, but in the sense of accumulating empirical facts. A sustained engagement with historical questions—especially those

[9] We are, Foster writes, dealing with a "succession of metabolic rifts. The second agricultural revolution, however useful in understanding this process, is just one stage" (personal communication, Foster to Moore, 20 January, 2000).

posed by environmental historians of agrarian change (e.g., Merchant 1980, 1989; Worster 1990; Cronon 1991)—has been sorely lacking. It is not clear to what degree this ahistorical tendency reflects contingent factors (e.g., scholarly interests) or disciplinary conventions, and to what degree it is immanent in the perspective. At best, we can say that history is consumed but not produced by Rift analysts. Nor does this consumption run deep: historiographies are rarely engaged, and the sources of historical evidence are thin.[10] (Not just geographers, but historians too are excluded from Foster's Red-Green canon.) When historical case studies are offered, as we shall see, they are situated within a larger descriptive category (a "global metabolic rift") that is the product of abstract generalization rather than dialectical reconstruction (e.g., Clark and Foster 2009; Longo and Clark 2012). In dialectical constructions, we would expect to find the concept of the whole (the global metabolic rift) revised through a method the follows the movements of parts and wholes through time, space, and nature (Hopkins 1982). With abstract generalization, we find little modification of the initial concept of the whole. In such instances, the concept becomes a box to fill with evidence: an "ecological rift."

I write these words having spent much of the decade following Foster's 1999 article wrestling with the "metabolism of nature *and* society" in historical explanation. Initially, I followed closely in Foster's footsteps. I identified biophysical changes—in soil fertility and deforestation—as decisive factors in the geographical expansion of early capitalism (Moore 2000a, 2000b, 2003a, 2003b, 2003c). After a certain point, however, I found that this arithmetic—economy plus environment—could not explain early capitalism's dynamism. For one, changes at the point of commodity production were simultaneously *human*, as well as extra-human. The metabolic "rupture" in nutrient cycling was not at all limited to nutrients. *Work* was central—and that work implicated not just the bodies of workers in the immediate process of production, but family life and the more expansive relations of reproductive labor. Flows of humans, and their intergenerational and daily reproduction of life (and labor-power), were transformed in a manner that did not fit the dualist frame of social and natural metabolisms. The large-scale resettlement of Andean populations following 1571, for instance, was premised on the need to supply cheap labor-power to the great silver mines of Potosí.[11] A long-run demographic exhaustion ensued, one turning rather more on shift than rift: cascading socio-ecological transformations of land, labor, and community (2010b, 2010e). It was a process that defied any neat and tidy boundary between two metabolisms. (Incidentally, such binaries are consistently opposed by Andeans to this day.) Here a *singular* metabolism of production and reproduction was at work.

I grew more skeptical as I discovered how one dualism quickly led to others. The Rift's Nature/Society dualism was paired with another: base/superstructure. As one engages the history of capitalism, not as a general model but as a series of historical patterns and punctuated developments, it becomes clear that ideas and symbolic praxis matter deeply to the unfolding of systemic metabolisms. There is, then, a counterpoint

[10] Thus Clark and Foster (2010) discuss the transition from feudalism to capitalism by citing the philosopher Mészáros.

[11] Indeed, the history of labor reserves often reveals a strikingly similar historical-geographical resemblance to the history of agro-ecological change and extraction; the two are best viewed as internally relational to each other (Meillasoux 1981; Moore 2015a, pp. 221–240).

to Foster's important account of the development of materialist thought in the modern world (2000a): this is the emergence of modern science as a force of production (Moore 2015a, pp. 193–217; Brockway 1978). The rise of capitalism as an economic and territorial project was, at every turn, enabled by a series of botanical, cartographic, mathematical, and other scientific revolutions, broadly conceived. The first thing that every European empire did was to establish means of mapping space and Nature, what Cañizares-Esguerra aptly calls the "primitive accumulation of botanical knowledge" (2004). The rise of calculative rationality, the mapping of abstract space, the formalization of abstract time through mechanical clocks—all these and other "measures of reality" were central to the emergence of capitalism as a system of cheap nature (Crosby 1997; Mumford 1934; Cosgrove 2008; Moore 2015a, pp. 193–217).

In place of an economy/ecology ping-pong of consequences and restructuring—my point of departure—a different picture began to emerge. I came to see the rise of capitalism as a set of cascading material-symbolic processes cutting across and destabilizing the Cartesian's divide's tidy boundaries: the transformations of landscapes, the restructuring of village and family life, the production of scientific knowledges, new cartographies and map consciousness, innovations in production and exchange, the emergence of new forms of state and imperial power. These constituted an evolving totality in which capitalist and territorialist agencies sought to remake the relations between humans and the rest of nature. At the same time, this grand project to reshape the world in service to capital accumulation was also shaped by all manner of unruly natures, from diseases to slave and peasant revolts to the Little Ice Age (Moore 2007, 2009, 2010a, 2010b, 2010d, 2010e, 2016b, 2017a).

Absent sustained historical analysis, socio-metabolic dualism has *under*emphasized the active role of extra-human natures in historical change. A Vampire Model dominates: planetary nature appears mainly as something to be sucked dry by capital. Here is a disruptionist perspective: "Natural" systems are *disrupted* by "social" systems (Clark and York 2005; Clausen and Clark 2005; Longo 2012; Mancus 2007; Foster 2013). The language is illuminating. Society *disrupts* Nature. Nature *reacts* to Society. Here is mechanical, not dialectical, reason. In this view, disruption rests upon humanity's special (and in my view unwarranted) ontological status: when humans alter ecosystem flows they *disrupt*, but when beavers change stream flows by making dams they are *natural*? There is—of course!—a mighty difference between these two forms of environment-making; the point is that recourse to disruption defaults to a view of nature as pristine and essentially ahistorical, one in which human use is impossible to distinguish from capitalist transformation.[12]

In this respect, Clark and York amplify the soft dualism of Foster's early formulation of the metabolic rift. For the former, disruption implies and necessitates an external, *separate*, relation of the acting unit ("capital" or "society") to the system being disrupted (York 2010). This entails a concept of capitalism as ontologically independent of nature—the consequences of the "law of value" may be asserted, but the origin of the law of value as such is treated as a kind of Cartesian Virgin Birth.

This overlooks a crucial civilizational choice. Capitalism's distinctiveness rests upon its capacity to appropriate uncapitalized natures—including unpaid human work—in order advance labor productivity within a narrow sphere (the zone of commodification).

[12] Fundamental critiques of pristine nature in historical studies include Cronon (1995) and Williams (1980).

This cheap nature orientation revealed itself in the audacious landscape transformations of the early modern era—outstripping, by an order of magnitude, the scale, scope, and speed of pre-capitalist environment-making (Moore 2007, 2010a, 2010b, 2015a, 2016a, 2017a). A focus on "environmental" consequences rather than the socio-ecological constitution of modernity's relations of power and re/production is certainly permissible. The difficulty emerges when it becomes a bias that blinds the analyst to how imperialism, or industrialization, or world hegemonies are not merely producers but *products* of a web of life that includes humans. To be sure, consequences matter. But if all one sees are consequences, there is a problem; causation and consequence enfold each other.

Green Thought's *consequentialist bias* has not stopped Rift analysts from speaking of the "nature-society dialectic." The language—"nature-society dialectic"—is understandable. Many of us in critical environmental studies have been striving for a dialectical approach to history in the web of life. At best, the phrase is a placeholder. And as a placeholder, it has encouraged a mighty confusion: between dialectics and interaction. The two are not synonymous. Interaction does not require mutual determination. Dialectics, however, requires not only mutual determination but also historically-grounded asymmetries (capital/labor, town/country, value/use-value, etc.) whose contradictions, ultimately, negate the original terms of the dialectic. Capital/labor, for instance, is understood *dialectically* as a relation that unfolds historically, such that labor's (hypothetical) triumph transcends the capital/labor relation. In Rift arguments, however, the dialectics of transcendence, of moving beyond, seldom appear. Dialectics too often appears as window dressing for denunciations of capitalism, which unfortunately say too little about *how* capitalism is co-produced by the rest of nature. We are instead offered a uni-directional model of "capitalism's war on the earth" and told of the coming "catastrophe" (Foster et al. 2010). In this rhetorical flourish we find a radical inflection of the ecological footprint metaphor (Wackernagel and Rees 1996), in which humans leave their mark on an "ecology" that is little more than passive mud and dirt. Even when asserting that humans are a part of nature, the language of Nature/Society freezes precisely what a dialectical method would loosen.

The inner connections between what looks social and what looks ecological cannot be located either by the "social cause-environmental consequence" model or its inverse. The boundary-setting procedure between the two can, however, be "incorporated" into the mode and method of analysis—just as an earlier generation of scholars incorporated national units into the study of transnational social change (McMichael 1990). Such a method allows the boundaries of the "social" and the "environmental" to dissolve through historical research. This is the movement from general to determinate abstraction and from the environmental histories *of* capitalism to capitalism *as* environmental history.

Historical change *as* environmental history—this sounds good, but remains pitched at a high level of abstraction. For a way of looking at—and dissolving the firewalls between—Nature and Society implies not only a philosophical and methodological alternative, but also a mode of theorizing. That mode pivots on the co-productions of humanity-in-nature and nature-in-humanity: the double internality.

Just how to bind this double internality in a non-reductionist way is unclear. One way forward is found in Foster's early formulation of metabolic rift (2000a; also Burkett 1999). In Foster's hands, the law of value—at least implicitly (2000a, pp.

167–168)—assumes particular geographical forms, above all in the town-country dialectic within states, and between metropole and colony on a world-scale (1999, p. 384). For Marx, and I think also for Foster, these geographical forms are not epiphenomenal; they are dialectically joined to value as socio-ecological project and process. Foster was, in other words, proposing the town-country relation and its metabolism as pivotal geographical moments of the law of value (Moore 2000a, 2011a, b).

The geographical-relational point cannot be overstated. The Rift is frequently understood and utilized as a general abstraction—an "ecological rift"—in terms of highly generalized push-pull of capitalist demands upon, and specific "disruptions" of, *the* "natural metabolism" (Foster et al. 2010; Clark and York 2005). The metabolic relation between specific geographical forms and value relations has been thoroughly abstracted in these recent arguments. A new general formula emerges: "the *essence* of a metabolic rift is the rupture or interruption of a natural system" (ibid., p. 400)—an argument that owes more to John Muir than to Karl Marx. Having established a quasi-positivist generalization of metabolism, for instance, Clark and York are able to re-insert value and space into the "general properties" of the "metabolic rift between nature and society" (ibid., p. 391). It is, then, not just nature that gets reduced to an additive factor in such accounts; so too is time, space, and class—exactly what Marx synthesizes in his theory of value (Harvey 1982; Burkett 1999). In the process, the historicity and spatiality of Marx's relational thinking is lost.

The perils of universalizing comparison: ecological imperialism

It is tempting to read Foster's Rift argument as a conventional social scientist—as a "concept-indicator approach" through which one deploys indicators of the "degree-of or amount-of" Rift and ensuing degradation (Hopkins 1982, p. 201). Indeed this is what the Rift has become. Rather than follow part-whole movements in successive determinations and juxtapositions—through which the "whole" in question (the Rift) undergoes qualitative transformation—Rift arguments have pursued a "general properties" approach (e.g., Clark and York 2005, p. 391). I do not think this is what Foster was doing in *Marx's Ecology*. Nevertheless, Rift arguments have morphed into a *generalizing narrative* governed by a general abstraction: "a disruption of the interchange between society and nature" (York 2007, p. 860). In this, particularity expresses "qualities or tendencies preordained by a prior law" (Araghi and McMichael 2017). "Prior law" manifests as a structurally invariant logic of capital, largely insulated from regional changes that issue from this logic.[13] One dualism—Nature/Society—finds a comfortable bedfellow with another: the general and the particular.

[13] Here is another blind-spot emerging from Foster's distance from geographical thought. Regional-scale socio-ecological transformations are deeply implicated in transformations of the capitalist world-ecology—not only its booms but also its slumps—something the history of commodity frontiers makes plain (e.g., Moore 2003a, 2007, 2015a). Severing geography from the general model therefore leads not only to an exaggeration of "social" over "ecological" moments but also to systemic determinism in which regional particularity and change has little analytical traction.

This generalizing approach flattens the historical narrative to one of cumulative change, expressions of a secular capitalist logic. Such cumulative change *is* part of an adequate historical geography of capitalism. Long-run patterns of proletarianization, commercialization, and landscape change cannot be understood bereft of their cumulative dimensions. But this can never be more than part of the story.

The Rift's generalizing narrative elides two decisive phenomena. First, eras of capitalist development are not reducible to the cumulative evolution of a quantitatively-expanding world-system; phases of capitalist development imply and necessitate moments of *qualitative* transformations (Arrighi 1994). (These are the transformations narrated by the historiographies of "revolution": scientific, industrial, democratic, and otherwise.) Second, such qualitative transformations mark the transition from one crystallization of power, re/production, and nature to another in historical capitalism (Moore 2011b).

In these transitions, strategic points of fracture in the capitalist world-ecology may shift—sometimes rapidly, often unpredictably. Green Arithmetic gives us two choices about these shifts: "environmental" or "social." But when one considers truly epoch-making eras of transition, we see that environmental moments bundle with the social, and vice versa. What changes is the strategic "bundle" of relations from one moment to the next. The story of the long nineteenth-century's Industrial Revolution, for instance, cannot be reduced to "coal" and "colonies"—or more recently, to "coal" and the "class struggle" (e.g., Pomeranz 2000; Malm 2016). This was an era in which the decisive transformations—of agrarian class structures (and peasant revolts), technical changes in industry (and labor unrest), territorial power and geopolitics, the expansion of the world market—were bundled with (and within) nature at every turn. In such *conjonctures*, the cyclical moment moves to center stage; the contradictions of class, re/production, and empire unfold in ways that seldom fit neatly with generalizing narratives—or with Green Arithmetic. Here we may underscore how the flattening of historical time, issuing from a generalizing narrative of metabolic rift, is closely linked to a flattening of geographical space ("nature in general"). I have elsewhere characterized Rift analyses as "lost in space" (Moore 2011a, b). It is more nearly accurate to say that these analyses are lost *without* space. Environmental social science abstracted from geographical difference is hobbled from the outset.

We are therefore dealing with a Rift perspective that is not only ontologically but methodologically dualist. The Cartesian dualism of Nature/Society is bound to an *epistemic* dualism—of the general and the particular—characteristic of positivism. Clark and Foster's engagement with the history of imperialism is a good example of this quasi-positivist construction. Ecological imperialism, for Clark and Foster, "entails control over natural resources, creates asymmetries in the exploitation of the environment and unequal exchange" (2009, p. 313; also idem 2004, p. 187). This form of imperialism can be seen "all around us.... [in] the invasion of occupation of Iraq ... the renewed scramble for Africa, the flooding of the global commons with carbon dioxide, or biopiracy aimed at Third World germplasm" (idem 2009, p. 311). Ecological imperialism, in this scheme of things, is the "growth of the center of the system at unsustainable rates, through the more thoroughgoing ecological degradation of the periphery"

(ibid., p. 331). A capacious concept indeed! It leaves us with something of a kitchen sink conception that goes everywhere and nowhere at once. No clear line of historical investigation and interpretation is laid out, as a general notion of ecological imperialism is presented—then collapsed—into a "global metabolic rift" (ibid.).[14]

The mode of argumentation finds strong expression their favored case of the nineteenth century's Anglo-Peruvian guano trade. But it is far from clear what this is a case *of*. Nowhere do we get something like a working set of causal propositions regarding the historical sequences Foster and Clark seek to explain. They overlay global metabolic rift and ecological imperialism upon an older *dependencia* analysis without much cross-fertilization (e.g., Galeano 1973). It is, moreover, difficult to see the difference between the two concepts—and the processes they signify. On the one hand, we are told that the global metabolic rift involves the transfer of "guano and nitrates … from Peru and Chile to Britain (and other nations) in order to enrich their diminished soils" (Clark and Foster 2009, p. 313). On the other hand, "the development of ecological imperialism necessitated … an enormous net flow of ecological resources from South to North" (ibid, p. 330). Is this nit-picky? I don't think so. The authors are not writing a world environmental history of the guano trade,[15] but rather pursuing a "larger *theory* of global metabolic rift, which captures the underlying nature of the capitalist relation to the environment" (ibid.). Their ambition is nothing short of transforming "Marxist theory as a whole" (idem 2004, p. 187). My concern is not the mis-identification of descriptive categories for a "larger theory," but rather to ask, "What kind of *historical explanation does* this 'larger theory' suggests?"

Two problems immediately present themselves, historical and geographical in their respective turns. While Foster, Clark, and York refer to a global metabolic rift, they deploy a generalized conception of the rift that confuses level of abstraction and geographical scale (esp. York and Clark 2010a, b, p. 210 and *passim*). *Global*, in their hands, is not a geographical category but a general assertion of how capitalism "*creates* a rift in *our* social metabolism with nature" (Clark and York 2005, p. 399, emphases added). The "global" is not constructed dialectically, as a real historical-geographical place with distinctive patterns—and generative antagonisms—of culture, re/production, governance, and exchange (Moore 2010a, 2010b; Taylor 1999). Rather, it is asserted as a statement of general theory, subsequently valorized by the empirical analysis of the particular. The ontology affects the historical narrative: the conception of social relations as forming independently of the web of life leads to a way of writing history in which an ontologically independent "society" goes out into "nature" and does all sorts of terrible things.

This narrative—capitalism wreaking havoc with external nature—bears more than a family resemblance to another narrative thread: capitalism forming within England, and subsequently expanding, in the process "creating a global metabolic rift" (Clark and

[14] Ibid. Such collapsing of general categories into an even more general category, with little sense of dialectical abstraction, is a common procedure in rift analyses (see Clark and York 2013, 27ff).

[15] On this history, see Mellilo's exciting study (2015).

Foster 2012, p. 72).[16] The essential thrust of metabolic rift arguments about capitalism and nature—the uni-directional impress of capital on external nature (Foster and Holleman 2014, p. 228)—is recapitulated in the narrative: England developed capitalism first through its distinctive agricultural revolution, which upon finding its progress stymied by soil fertility problems, "creates" a *global* metabolic rift by variously "robbing" or "plundering" "distant regions" (Clark and Foster 2009, p. 312; idem, 2004, p. 193; York and Clark 2010a, b, p. 212)." Capital imposes its footprint on "nature"; "core nations" impose their will upon the periphery.

"Global" or historical formation? agricultural revolution as metabolic shift

It is of course true that capitalist relations of power and production encompassed, in a very broad sense, most of the planet by the eve of World War I. And we know that this entailed a new regime of global inequality (Davis 2001). This new regime encompassed both quantitative and qualitative phenomena. The difficulty is that Rift approaches treat neither history nor space as much more than quanta in their model, evacuating the qualitative moment. Clark and Foster's historical explanation of the "emergence" of a global metabolic rift in the nineteenth century runs something like this. Soil exhaustion within England drives the British Empire to find new sources of fertilizer, which leads to the neo-colonial subordination of Peru, which leads to guano flowing from Peru back to England. Hence, the global metabolic rift. National, global, *plus ça change* ... Nothing really changes but the scale of activity. The global rift's governing relations do not change. The nineteenth-century geographical restructuring of capitalism, in this interpretation, has no import on the *relations* of power and re/production. Space, like nature, becomes a mere substrate upon which capitalist relations—"whether through colonialism, imperialism, or market forces" (Clark and York 2012, p. 27)—impose their logic.

I do not think such an approach adequately comprehends historical-geographical change, arguably the core thematic of environmental studies. The conflation of the "global" and the "general" in Rift arguments is but a salient example. In the first place, it is reasonably clear that the historical-geographical processes Foster and his colleagues ascribe to the nineteenth century were in motion much earlier, certainly from the "long" sixteenth century. The early modern intertwining of imperial power and massive and rapid landscape transformation is a key moment of modern world history—illuminated, above all, by the experience of the Dutch, Spanish, and Portuguese empires between 1450 and 1750. Such expansion encompassed commodity frontiers

[16] York and Clark (2010a, b) are especially relaxed about historical specificity, invoking (but little beyond) to the *longue durée* of historical capitalism. But the *longue durée* is invoked rather than integrated; it is simply a "long time" for York and Clark, not a co-produced and multi-layered temporality (Braudel 2009). In the main, Rift analyses evoke the idea of history without practicing historical analysis. My point is not topical ("they do not study history") but rather an observation of their theoretical praxis: the investigation of historical change does not seem to alter their framework. For instance, the centrality of the "second" agricultural revolution in metabolic rift thinking has been asserted with scarcely a nod to the historiography of English agriculture in the nineteenth century. An alternative approach is Duncan's (1996)—whose conclusions I do not share but whose engagement with history and historiography is serious and sustained.

within Europe as well as outside, from Bahia to the Baltic, and even as far afield as the Moluccas in southeast Asia (Moore 2010a, 2010b, 2016b).

Second, the drive towards soil exhaustion is much more plastic and punctuated than rift analysts suggest. We return to this issue below. The point I wish to underline is that Rift scholars have converted a definite socio-ecological tendency into a *universalizing comparison*, in which "every instance of a phenomenon follows essentially the same rule" (Tilly 1984, p. 82). This approach runs directly counter to a historical method that *takes variation and divergence as its point of departure* (e.g., Poly and Bournazel 1997; Tomich 2004). The point is crucial, for it distinguishes a method that takes variation and divergence as its starting point and one that is capacious enough to allow for considerable wobble room—as is the case with the "ecological rift." The universal phenomenon of the metabolic rift can easily enlist highly variant empirical consequences because it *is* so universal. Descriptively, then, the metabolic rift works well, since fertility problems are endemic to agriculture—and not just capitalist agriculture. In universalizing a particular moment (fertility and depletion), however, its explanatory power is weakened. Commodity-oriented agriculture is not determined by soil fertility directly, but rather through a spectrum of processes, including labor supplies, class structure, chemical and mechanical forces of production, agronomy, etc. Soil fertility, in turn, is doubly plastic, as what matters to any particular cultivator is the cost/price spread and farm-level reproduction costs.[17]

Whether or not we are dealing with correlation or causation is difficult to say. Soil and resource depletion can be seen everywhere, but its significance is nearly everywhere undertheorized (Engel-Di Mauro 2014). Environmental historiography goes far towards describing such depletion (and much more than this), but has been reluctant to build out explanatory models (Moore 2003a; but see Merchant 1989; Worster 1990). Historical sociologists have sometimes gone further, as in Bunker and Ciccantell's argument for comprehending power, wealth, and ecology in the modern world through capitalism's "materio-spatial logic" (2005, p. 26). But Rift scholars have had nearly nothing to say about how to translate environmental historiography's insights into broader explanatory models. Perhaps more surprisingly, they have evinced little interest in theorizing historical change, content to assert the primacy of capitalism. Thus we are left with a "theory of metabolic rift" that contains very little theorization. Beyond a soil/resource exhaustion thesis and a general notion that capitalism does bad things to nature, Rift thinking elaborates few working propositions on how capital, power, and nature operate historically. Lacking theory, we are treated to a series of axioms that substitute for theory-construction.

I state the matter so bluntly because I think Rift analysis has, in recent years, blunted and discouraged the development of a relational theory of capitalism-in-nature. There *is* a historical tendency at work that involves soil fertility. In successive eras of agricultural development, yield growth reaches a ceiling beyond which new gains are increasingly modest. This threatens to undermine labor productivity and increase reproduction costs for labor-power. This is a cyclical phenomenon of the capitalist world-ecology, as dominant agricultural models emerge, develop, and enter into crisis (Moore 2010c).

[17] American agriculture between 1860 and 1930, for example, saw no meaningful change in land productivity, but a galloping pace of rising labor productivity—notwithstanding an important tendency towards soil exhaustion (Kloppenburg 1988; Cunfer 2004).

These models are famously narrated in the history of the Dutch, English, American, and "Green" agricultural revolutions,[18] but they also comprise successive organizations of botanical imperialism and cash-crop regimes across the periphery (Brockway 1978; Schiebinger and Swan 2005; Galloway 1989). The decisive lesson of these agricultural revolutions is that every spatial re-centering of agro-ecological production—each with specific, commodity-inflected geographies—entails a qualitative restructuring of the totality of agrarian relations: class structure, the range of necessary inputs, transportation infrastructure, the organization of money and credit, techniques of cultivation. The highly capitalized family farm in late nineteenth-century Iowa bore little resemblance to the landlord-tenant relations that dominated the English countryside at the end of the seventeenth century. To be sure, soil fertility is a key moment in the story. By itself, however, it tells us little directly about how agricultural revolutions run out of steam, or how new agricultural revolutions take root and take flight. Soil fertility is a necessary condition, but pedology itself is insufficient to shoulder either the theoretical and historical burden assigned to it by Rift analysts.

While the "declining soil fertility leads to ecological imperialism" model has some teeth for the English case, it does not work well for either the Dutch agricultural revolution before it or the American agricultural revolutions after it. Each "hegemonic" agro-ecological regime must find a way to deal with the productivity problem—but that productivity problem assumes new forms in each era. These agro-ecological fixes are instances of humans "mixing [their] labor with the earth," (Williams 1980, p. 83), and inexplicable either in terms of institutional renovation, class restructuring, *or* landscape change as such. (An adequate explanation will focus on how these moments of class, organization, and land *fit together*.) The British in the long nineteenth century dealt with stagnant agricultural productivity growth—in motion from the 1760s—in part through a phosphate-acquisition strategy, but in the main by outsourcing food production to the Americans, whose agro-industrial revolution gathered steamed after 1840 (Moore 2015b). But the American agro-industrial revolution, as world-ecological fix,[19] cannot be chalked up to differential fertility as such. It took shape through a series of mutually reinforcing shifts: in the sociology of cultivation (the capitalized family farm model) (Friedmann 1978); the early Republic's consolidation of a spatial regime that allowed for territorial expansion and a far-reaching rationalization of continental space (Parenti 2015); a canal-railroad revolution (Taylor 1951); the development of financial and futures markets that allowed for, say, Illinois wheat to be turned into abstract grain, and which enabled foreign, mainly English, investors to hold a quarter of American rail bonds by mid-century (Cronon 1991, ch. 3; Sobel 1965, p. 57). This is not an exhaustive list. The point is to show that "soil" and the organizational apparatus of "capital" and "state" were moments of a singular metabolism.

Second, the Rift's conflation of "periphery" and "countryside" obscures capitalism's profound agro-ecological variability and unevenness. Countrysides may be relatively rich or poor: contrast Iowa with Chiapas. These varied fixes took different forms in successive eras. For the sixteenth-century Dutch, it was a neo-colonial market relation

[18] Useful points of entry for these revolutions include, respectively, Hoppenbrouwers, and van Zanden (2001), Overton (1996); Post (2011), Walker (2004); Patel (2013).

[19] The language of world-ecological fix is a socio-ecological elaboration of Harvey's theory (1982a), extending his focus on built environments and investment flows to the town-country relation on a world-scale (Moore 2015a).

with Polish seigneurs and enserfed labor. For the nineteenth-century English, it was in part the guano trade and cognate processes elsewhere, but in the main another, more politically-mediated, market fix through of American agro-industrialization. For the Americans, the slowdown of labor productivity after 1900 was resolved through geographical re-centering (the rise of California agriculture), and the hybridization and the chemical-fertilization revolution after 1935.[20] Peripheral spaces may or may not be agrarian; agrarian spaces may or may not be peripheral.

Third, while Rift analysts rightly note the importance of "marking specific changes within a mode of production" (York and Clark 2010a, b, p. 210), the reordering of labor, energy, environment, and so forth is asserted axiomatically, rather than constructed historically. In short, a stadial conception of capitalism is embraced discursively, but with little sense in which the feedback of agro-ecological and extractive restructuring in core and periphery shapes power and production in capitalism as a whole. Regional shifts are described—sometimes with rich empirical detail—but it is difficult to see how regional change co-produces global change. This is the danger of the Rift's unidirectional "footprint" approach. It obscures how modernity's relations are reproduced in law like *but quasi-contingent form across geographical scales and regions*, and it underestimates the resistances of human and extra-human natures (e.g., weeds, diseases, invasive species, biological exchanges, peasant revolts, etc.).

My sense is that the Rift argument has been given a pass by critical scholars because the perspective *has* delivered a real service: emphasizing the importance of environmental factors in the history of capitalism. It is now time to take up a new task: one in which we can transcend the abstract determinism of core determining periphery, capital determining nature (except in the ultimate "catastrophe"), and society determining space. All these themes make sense only if one ignores the central insight of four decades of critical human geography: namely, that all transformations of social relations are transformations of spatial relations (Lefebvre 1991; Harvey 1982a; Moore 2015a). In this perspective, capitalism not only occupies, but *produces*, space.[21] A quarter-century of robust research in political ecology demonstrates manifold instances of how these socio-spatial relations are also moments of co-production (Heynen et al. 2007; Peluso and Watts 2001; Peet et al. 2011). Capitalism not only occupies, but produces *and is produced* by, the web of life. Unfortunately, such insights have been excluded from Foster's canon of green Marxism (e.g., Foster 2016a). Such lacunae may owe something TO disciplinary insularity, but clearly disciplinary boundaries provide only a partial explanation. Global sociologists, for example, have critically engaged and elaborated Harvey's theory of spatial fix (1982). Consider, for example, Arrighi's influential thesis that every phase of capitalism must revolutionize its spatial relations of production, power, and accumulation (1994). Space is not a container within which social relations unfold. Neither is the web of life (Moore 2015a).

[20] See, respectively, Moore 2010b; Thomas 1993; Kloppenburg 1988; Walker 2004.

[21] "Before *producing* effects in the material realm (tools and objects), before *producing itself* by drawing nourishment from that realm, and before *reproducing itself by* generating other bodies, each living body *is* space and *has* its space: it produces itself in space and it also produces that space. This is a truly remarkable relationship: the body with the energies at its disposal, the living body, creates or produces its own space; conversely, the laws of space, which is to say the laws of discrimination in space, also govern the living body and the deployment of its energies" (Lefebvre 1991, p. 170).

In the rush to separate "ecological" from other forms of imperialism, Rift scholars have taken their eyes off the ball. Their catch-all category of ecological imperialism has distracted them from the most exciting possibilities of their historical analysis. These possibilities imply a rethinking of imperialism *as* an irreducibly socio-ecological process. "The trick," I wrote to Clark and Foster in 2002,

> is to incorporate ecological transformations into the theory of capitalist development and crisis (including imperialism) rather than to formulate ecological or "green" theories of crisis, imperialism, and so forth. [Capitalism's transformations] are (broadly speaking) ecological and not ecological at the same time. We need socio-ecological theories of these latter rather than social *and* ecological [theories]… The ecology question *is* the labor question *is* the agrarian question. If these "questions" were once somewhat distinct (although we know now know that they are much more closely articulated than we previously assumed) today capitalism has brought these questions/crises together [as never before].[22]

In such an approach, the particularities of Rift analysis might be reconceptualized. Imperialism, in its successive historical and geographical forms, could be reworked to highlight the strategic relations of world power and global inequality, incorporating organic and inorganic natures (humans included), symbolic praxis, and value.[23] Imperialism, in other words, would orient us towards the dynamic restructuring power, capital, and nature: imperialism as a tightly woven bundle of land/labor relations in service to metropolitan accumulation.

Dialectics/nature/method: whither the "great loosener"?

I have dwelt upon the conflation of the global metabolic rift and ecological imperialism for a specific reason: to underscore the disjuncture between the Rift's dialectical claims and its dualist practicality. To be sure, the translation of dialectics into world-historical method has been fraught. My point is not to insist on one "correct" method, but to sketch the outlines of a productive conversation around a world-historical method that grasps the messy and porous interpenetration of human and extra-human natures. At a minimum, such a method implies the successive reordering of a perspective's conceptual frames in light of empirical investigation—such that the incorporation of new empirical phenomena allows for conceptual reflexivity. A perspective that emerges with one conception of capitalism and nature and finds itself with the same conception a decade or two later is unlikely to be practicing a dialectical method.[24] Not for nothing does Bhaskar describe dialectics as the "great loosener" of established binaries (2008, p. 354).

Where is the "great loosener" in Rift categories of nature, disruption, alienation, separation, society, capitalism, and crisis? This is difficult to see. The crucial dialectical

[22] Personal communication, J.W. Moore to J.B. Foster and B. Clark, November 27, 2002.
[23] See Frame (2016) for a suggestive analysis along these lines.
[24] This is a dialectical inflection of Lakatos's oft-quoted observation: "A research programme … is *stagnating* if its theoretical growth lags behind its empirical growth" (1978, p. 112).

procedure of sorting out the relation between the concept of a relation and the relation itself—between signifier and signified—is conspicuously absent in most Rift analyses. Nature, in particular, is taken as the object from which empirical facts can be wrested rather unproblematically and in which the work of "natural scientists" is unduly insulated from conceptual critique.[25]

Even when Clark and Foster speak of the "interpenetration of nature and society" (2010, p. 126, 2013, p. 69), it is hard to see that claim at work. Dialectical interpenetration is messy and disruptive—even the luminaries of the dialectical method find it difficult to put into practice (e.g., Ollman 2003). Rift arguments celebrate interpenetration and yet practically embrace the inviolability of Nature/Society as basic unit. Nature relates to society, to be sure, but is *independent of it* (Clark and Foster 2012, p. 68). Society, too, relates to Nature, but as basic unit rather than dialectical moment: "[H]umans have the potential to alter the conditions of life in ways that surpass *natural* limits and undermine the reproduction of *natural* systems" (Clark and Foster 2010, p. 126).

Nearly two decades after Foster's initial formulations, one can scarcely detect any reconceptualization of Nature/Society or of the relations between the two. Indeed, quite the contrary! Foster has doubled down on his methodological dualism, at once proclaiming the usefulness of general abstraction and denying that Rift arguments are dualist. Foster rightly notes that one may employ "conceptions that at first sight—when separated out from the overall dynamics—may appear one-sided, mechanical, dualistic, or reductionist" (2013, p. 9). Such conceptions isolate crucial "mediating relations" *en route* to comprehending "the larger concrete totality" of capitalism.

No one is arguing this point. The problem with Foster's clarification is that it begs the question: *What is the procedure of abstraction that governs the conceptualization of mediating relations?* There is no more fundamental a question in Marxist method, given its view of capital and class as ontological conditions of capitalist development. Consider the (absurd) thought-experiment of a Marxist conception of the state or mode or production abstracted from capital and class. If Foster's argument for metabolism as immanent to class and capital holds—as I think it does—the metabolic moment of class and capital cannot be abstracted. Metabolism operates simultaneously as outer and inner moment of capital accumulation.

Significantly, Foster follows his defense of one-sided determinations—abstracted from metabolism—by banishing biospheric nature to an "outer set of conditions or boundary" (ibid.). That's a telling defense, for two reasons. First, to be sure, the web of life *is* an absolute limit in some highly abstract sense. That tells us *what* but not *how*. Historical explanation turns on how capitalism's thick processes (its "mediating relations")—racialization and patriarchies, imperialism and industrialization, class struggles and geopolitics—are irreducibly socio-ecological. Try making sense of class, race, and gender—and the diversity of forms, historically and spatially—abstracted from the

[25] "Facts in science do not present themselves in a preexistent shape. Rather it is the experimental or observational protocol that constructs facts out of an undifferentiated nature. And if we do not like what we see, we can rearrange the description of nature to have a more pleasing aspect. *So facts make a theory, but it takes a theory to make facts*" (Lewontin 1991, p. 147, emphasis added). The celebration of "natural science" and "natural scientists" runs throughout the arguments of Foster and his colleagues and is often paired with the characterization of "social science" as comparatively uncritical and "quiescent" (see especially Foster et al. 2010, pp. 19–24).

eco-geographical relations within which they unfold and that they in turn re/produce. Second, the defense of dualism as a means to, *eventually*, recombining the elements is reasonable—*but only a for a time*. Today, for the Rift, the bloom is off the rose. At some point, a new synthesis must take shape.

Foster, Marx, and metabolism: a relational alternative

For environmental scholars and activists, the great worry is that a relational ontology of humans in the web of life erases the question of nature and materiality. This worry has motivated Foster's defense of dualist practicality. Against this, we can balance a second concern: namely that the defense of dualism reinforces variants of "wilderness fundamentalism" and "labor fundamentalism." That Red and Green divide has significant political implications that go well beyond debates over historical method. One-sided determinations can work, but only within a dialectical trajectory committed to synthesis. Thus, Foster's defense of one-sided abstractions serves equally well as critique. As Walker puts it,

> Environmentalists may object that in this solution nature seems to disappear into labor. But that's not the case. Natural systems and processes continue to dominate in a universe in which human beings are a very small part. Within the limited domain of economic production, however, things are reversed. Human beings are necessarily the initiating partners who put natural materials and forces to work in a pre-determined manner; this is why Marx continued to assert that labor was the active force in production. It is neither dualistic thinking nor runaway humanism to say that there is a dominant element in the combination of labor-nature relations, even though labor cannot function without its natural partner and labor does not have absolute command over natural forces (whatever humans may imagine!) 2017, 57.

I would take the argument one step further. Dialectically speaking, one-sided determinations have a shelf life. The power of dialectical method is to show how a one-sided contradiction creates, historically, the conditions of its transcendence. Alongside Walker's geographical frame—that while the web of life dominates, in "economic production things are reversed"—I would add a historical argument. The history of capitalism generates a tendency that undermines the bourgeoisie's capacity to accumulate through labor-in-nature. In "economic production," things are reversed *only so long as frontiers of uncapitalized nature exist*. These offset entropic tendencies and enable the bourgeoisie's "domination" in production. Over time, however, a counter-tendency undoes the bourgeoisie's "one-sided" determination. This is the activation of negative-value, understood as the evolution and emergence of forms of nature—including the new ontological politics of food and climate justice—that cannot be "fixed" through capitalism's productivist logic. Climate change, new diseases, and superweeds are important instances of negative-value's activations (Moore 2015b; Wallace 2016). Far from denying limits—as Foster has argued (2017)—such an approach clarifies how such limits are formed through capitalism's specific configurations in the web of life.

To be sure, the optic of a "singular metabolism" appears starkly different from Rift arguments today. I nevertheless think there is some common ground. Foster's early formulations may be fruitfully recast through Marx's philosophy of internal relations (McMichael 1990; Hopkins 1982; Moore 2015a; Ollman 2003). The metabolic rift may be reconceptualized through capitalism's *longue durée* reconfigurations of human and extra-human natures (Moore 2000a). These reconfigurations are simultaneously—and in asymmetrically variant fashion—propelled by the web of life. In such a method, systemic determinism and regional particularism are ruled out; "systemic" changes occur in overlapping planetary, systemic, regional, and bodily registers. Historically- and geographically-specific metabolic flows and configurations not only express—*they co-produce*—world-historical cycles and trends. The metabolic rift is, then, *historically constructed* through distinct and manifold forms of environment-making—by human and extra-human natures cohered in particular civilizations and their rules of reproduction. These latter are understood as "mutually-conditioning moments of a singular phenomenon," whose decisive features emerge out of successive part-whole movements (McMichael 1990, p. 391; also Kosík 1976). Dialectical constructions progressively erode whatever dualisms initially frame the analysis: hence Bhaskar's "great loosener." To grasp nature dialectically—as field and relation as well as object—is to move beyond chaotic conceptions and to unsettle our prevailing concepts of capitalism and its constitutive relations.

Foster's argument in *Marx's Ecology* may be re-read in this light. It allows us to see how metabolism could be integrated—*was already integrated*—into Marx's system of thought. In this respect, *Marx's Ecology* makes two enduring contributions. First, Foster gives us a picture of Marx's thinking about capitalism that transcends the Cartesian divide. *Marx's Ecology* is caught in a productive contradiction: between Marx's relational perspective on capital, class, and metabolism as internal relations and the consequentialist bias that sees nature as external object. Although Foster structures the narrative in arithmetic terms—"*combin[ing]* a materialist conception of history with a materialist conception of nature"—the argument leans heavily towards monist synthesis (singular metabolism) rather than dualist practicality (metabolism of nature and society) (Foster 2000a, p. 8).

A second contribution turns on Foster's handling of totality. *Marx's Ecology* argues that social totalities abstracted from nature are irremediably partial. Thus he criticizes the Frankfurt School for ignoring the "the real, material alienation of nature" under capitalism (2000a, p. 245).[26] Together, these contributions opened the possibility for unifying seemingly discrete elements of Marx's thought—and along with it, the seemingly discrete moments of "society" and "nature." The discovery of metabolism, Foster argues, allowed Marx—and by extension, could allow critical scholars today—to "tie together his critique of the three principal emphases of bourgeois political economy: the analysis of the extraction of surplus product from the direct producer [surplus value]; the related theory of capitalist ground rent; and the Malthusian theory of population" (2000a, p. 141). Rent, value, and socio-ecological reproduction: Foster

[26] But did not Foster invert the problem (2013)—recuperating material nature and refusing symbolic nature—in refusing the Frankfurt School's accounting of *symbolic* natures, not least the latter's elaboration of instrumental reason?

seems to be urging us to unify these dialectically, so that each moment constitutes, and is revealed through, the other, and the whole.

This reading *Marx's Ecology* has led me to conclusions that are very different from today's Rift perspective. These conclusions, taking shape through the world-ecology conversation, outline an alternative to metabolic rift as rupture and interruption. They are largely consonant with Foster's powerful emphasis on alienation, which is above all a constitutive and unifying relation rather than force of separation. In emphasizing *shift* rather than rift, I am suggesting that the most interesting questions—analytical, but also political—turn on the configurations of human and extra-human nature, and in how these are irreducibly socio-ecological and symbolic at the same time. This line of thought yields a co-productive ontology of metabolism, one fully consonant with locating "the human relation to nature as one that encompasse[s] both 'nature-imposed conditions' and the capacity of human beings to affect this process" (Foster 2000a, p. 158). Here Foster proposed a decisive break with human exemptionalism: the "materialist conception of nature [could become] fully integrated with [the] materialist conception of history" (2000a, p. 141).

The synthesis had been signaled previously (Williams 1980; Smith 1984; Harvey 1995). But in the early 2000s, Foster's world-historical sensibility (1994) promised to turn over a new leaf in the long-running tension between so-called constructionist and materialist perspectives. It seemed to call for a world-historical refoundation of environmentalist thought, allowing for a far-ranging reconstruction of how we narrate, analyze, and investigate historical capitalism. This new synthesis would comprise not only a revitalized and reworked historical materialism in line with Marx's system of thought. It would also actively pursue the renewal of value-relational thinking—the law of value as co-produced by humans and the rest of nature—offered by Burkett's pioneering *Marx and Nature* (1999), which Foster encourages us to think of as a companion to *Marx's Ecology* (2000a, p. 282n). The potential for synthesis was tantalizing. The incorporation of an ecologically-informed theory of value into historical materialism—the synthesis made possible by reading *Marx's Ecology* and *Marx and Nature* as a singular argument—would be a "groundbreaking" contribution whose importance "lies precisely in the fact that it traces capitalism's fundamental contradiction to the alienation of nature and the alienation of human production, *as two sides of a single contradiction*" (Foster 2000b, emphasis added). This would allow us to see the history of capitalism as a world history in which nature matters not merely as consequence, but as constitutive and active in the accumulation of abstract social labor.

Towards a singular metabolism

A singular metabolism underscores not society's subsumption of nature (Foster 2016) but its opposite: the limited capacities of human organizations to control and dominate nature (Moore 2015a). Indeed, Foster and I *agree* on the key point: human organizations unfold with a biosphere that shapes human sociality and is shaped by it. There are crucial differences in method of abstraction and historical method, with meaningful differences in the interpretation of the present crisis. These cannot be reduced—and meaningful conversation cannot be realized—by reducing these differences to inferred political position, that is reduced to the friends and enemies of Marxism and socialism (e.g., Foster 2016a).

Foster's original formulation of metabolic rift highlighted the irreducibly geographical character of human activity. It gave us a way to understand the geography of capitalism as an "ontological condition" (Pred 2006). Marx and Engels's argument about the urbanization of the countryside—a process unfolding through successive historical determinations—underscored how capitalism's relations of production, class, and accumulation enter into specific geographical forms, from their sixteenth century origins to the advent of large-scale industry (1970; Marx 1973, 1977: Part 8). These historical-geographical crystallizations do not produce a social metabolism that subsequently confronts a natural metabolism; they are co-produced *through* a singular metabolism in which humans—and human organizations—participate. Metabolisms are always geographical. Capitalist relations move through, not upon, space, which is to say through, and not upon, nature as a whole.

Put in these terms, the apparent solidity of town and country, bourgeois and proletarian, and above all Society and Nature, begins to melt. Metabolism, *liberated from dualisms,* acts as a solvent. For if metabolism is invoked as a way to think about nature as a totality of totalities in which life and matter enter into specific historical-geographical arrangements, an important task comes before us. We are called to construct much more supple and historically-sensitive families of concepts, unified by a dialectical method that transcends all manner of dualisms—not least, but not only, Nature/Society.

Acknowledgements Special thanks to Henry Bernstein, Phil Campanile, Jennifer Casolo, Sharae Deckard, Phil McMichael, Mike Niblett, Christian Parenti, Raj Patel, Alan Rudy, Dale Tomich, Richard Walker, and Anna Zalik for conversations on metabolism and dialectics. I am especially grateful to Diana C. Gildea and my students at Binghamton University (and elsewhere) for ongoing conversations about the "singular metabolism" of the capitalist world-ecology: Jay Bolthouse, Alvin A. Camba, Joshua Eichen, Benjamin Marley, Roberto José Ortiz, Andy Pragacz, Kyle Gibson, and Christopher Cox.

References

Abulafia, D. (2008). *The Discovery of Mankind*. New Haven: Yale University Press.
Altvater, E. (2016). The Capitalocene, or, Geoengineering against Capitalism's Planetary Boundaries. In J. W. Moore (Ed.), *Anthropocene or Capitalocene?* (pp. 138–152). Oakland: PM Press.
Araghi, F., and P. McMichael. (2017). Contextualizing (Post)modernity. *Review: A Journal of the Fernand Braudel Center.*
Arnold, D. (1996). *The Problem of Nature*. Oxford: Blackwell.
Arrighi, G. (1994). *The Long Twentieth Century*. London: Verso.
Bennett, J. (2009). *Vibrant Matter*. Durham: Duke Univ. Press.
Bhaskar, R. (2008). *Dialectic*. New York: Routledge.
Birch, C., & Cobb, J. B. (1981). *The Liberation of Life*. Cambridge: Cambridge University Press.
Bleichmar, D., De Vos, P., Huffine, K., & Sheehan K. (Eds.). (2009). *Science in the Spanish and Portuguese Empires, 1500–1800*. Stanford: Stanford University Press.
Bolthouse, J. (2014). Rethinking Capital's Relations to Nature. *Japanese Journal of Human Geography, 66*(6), 580–594.
Bourdieu, P., & Wacquant, L. J. D. (1992). *An Invitation to Reflexive Sociology*. Chicago: University of Chicago Press.
Braudel, F. (1953). Qu'est-ce que le XVIe siècle? *Annales E.S.C., 8*(1), 69–73.
Braudel, F. (1982). *The Wheels of Commerce*. New York: Harper & Row.
Braudel, F. (2009). History and the Social Sciences. *Review, 32*(3), 171–203.
Braun, B. and N. Castree, eds. (1998). *Remaking Reality*. New York: Routledge.

Brenner, R. (1976). Agrarian Class Structure and Economic Development in Pre-Industrial Europe. *Past & Present, 70*, 30–75.
Brenner, N. (Ed.). (2013). *Implosions/Explosions*. Berlin: Jovis.
Brockway, L. H. (1978). *Science and Colonial Expansion*. New York: Academic Press.
Bruce, B., & Castree, N. (Eds.). (1998). *Remaking Reality*. New York: Routledge.
Bunker, S. G., & Ciccantell, P. S. (2005). *Globalization and the Race for Resources*. Baltimore: Johns Hopkins University Press.
Burkett, P. (1999). *Marx and Nature*. New York: St. Martin's.
Burkett, P., & Foster, J. B. (2016). *Marx and the Earth*. Leiden: Brill.
Camba, A. A. (2015). From Colonialism to Neoliberalism. *Extractive Industries and Society, 2*, 287–301.
Campbell, C. (2016). Glancing backwards: George Lamming, John Cowper Powys and vexed visions of labour in the capitalist world-ecology. *Green Letters, 20*(2), 170–182.
Cañizares-Esguerra, J. (2004). Iberian science in the renaissance. *Perspectives on Science, 12*(1), 86–124.
Clark, B., & Foster, J. B. (2004). Ecological Imperialism. In L. Panitch & C. Leys (Eds.), *Socialist Register 2004* (pp. 186–201). London: Merlin Press.
Clark, B., & Foster, J. B. (2009). Ecological Imperialism and the Global Metabolic Rift. *International Journal of Comparative Sociology, 50*(3–4), 311–334.
Clark, B., & Foster, J. B. (2010). The Dialectic of Social and Ecological Metabolism. *Socialism and Democracy, 24*(2), 124–138.
Clark, B., & Foster, J. B. (2012). Guano. In A. Hornborg et al. (Eds.), *Ecology and Power* (pp. 68–82). New York: Routledge.
Clark, B., & York, R. (2005). Carbon Metabolism. *Theory and Society, 34*(4), 391–428.
Clark, B. and R. York (2012). Techno-Fix. Pp. \-36 in A. Hornborg, Brett Clark, and Kenneth Hermele, eds., Ecology and Power. New York: Routledge.
Clausen, R., & Clark, B. (2005). The Metabolic Rift and Marine Ecology. *Organization & Environment, 18*(4), 422–444.
Cosgrove, D. (2008). *Geography and Vision*. London: I.B. Tauris.
Cox, C. R. (2015). The Problematic Nature of 'the Anthropocene'. *Telos, 172*, 59–81.
Cronon, W. (1991). *Nature's Metropolis*. New York: W.W. Norton.
Cronon, W. (1995). The Trouble with Wilderness, or, Getting Back to the Wrong Nature. *Environmental History, 1*(1), 7–28.
Crosby, A. W. (1997). *The Measure of Reality*. Cambridge: Cambridge University Press.
Cunfer, G. (2004). Manure Matters on the Great Plains. *Journal of Interdisciplinary History, 34*(4), 539–567.
Davis, M. (2001). *Late Victorian Holocausts*. London: Verso.
de Vries, J., & van der Woude, A. (1997). *The First Modern Economy*. Cambridge: Cambridge University Press.
Deckard, S. (2016). World-Ecology and Ireland: The Neoliberal Ecological Regime. *Journal of World-Systems Research, 22*(1), 145–176.
Dixon, M. (2015). Biosecurity and the multiplication of crises in the Egyptian agri-food industry. *Geoforum, 61*, 90–100.
Duncan, C. A. M. (1996). *The Centrality of Agriculture*. Montreal: McGill-Queens University Press.
Dunlap, R. E., & Catton Jr., W. R. (1979). Environmental Sociology. *Annual Reviews in Sociology, 5*, 243–273.
El Khoury, A. (2015). *Globalization, Development, and Social Justice*. New York: Routledge.
Engel-Di Mauro, S. (2014). *Ecology, Soils, and the Left*. New York: Palgrave.
Federici, S. (2004). *Caliban and the witch*. New York: Autonomedia.
Fischer-Kowalski, M. (1997). Society's Metabolism. In M. R. Redclift & G. Woodgate (Eds.), *The International Handbook of Environmental Sociology* (pp. 119–137). Cheltenham: Edward Elgar.
Fischer-Kowalski, M., & Haberl, H. (1998). Sustainable Development. *International Social Science Journal, 158*, 573–587.
Foster, J. B. (1992). The Absolute General Law of Environmental Degradation Under Capitalism. *Capitalism Nature Socialism, 3*(2), 77–86.
Foster, J. B. (1993). The limits of environmentalism without class. *Capitalism Nature Socialism, 4*(1), 11–41.
Foster, J. B. (1994). *The Vulnerable Planet*. New York: Monthly Review Press.
Foster, J. B. (1999). Marx's Theory of Metabolic Rift. *American Journal of Sociology, 105*(2), 366–405.
Foster, J. B. (2000a). *Marx's Ecology*. New York: Monthly Review Press.
Foster, J.B. (2000b). Marx's Ecological Value Analysis. Monthly Review, 52(4), online, http://monthlyreview.org/2000/09/01/marxs-ecological-value-analysis.
Foster, J. B. (2009). *The Ecological Revolution*. New York: Monthly Review Press.

Foster, J. (2013a). Marx and the Rift in the Universal Metabolism of Nature. *Monthly Review 65/7, 2013*, 1–19.
Foster, J. B. (2013b). The Epochal Crisis, *Monthly Review, 65*(5), 1–17.
Foster, J. B. (2015). The Great Capitalist Climacteric. *Monthly Review, 67*(6), 1–18.
Foster, J.B. (2016a). In defense of ecological Marxism. http://climateandcapitalism.com/2016/06/06/in-defense-of-ecological-marxism-john-bellamy-foster-responds-to-a-critic/, retrieved 4 June, 2016.
Foster, J.B. (2016b). Marxism in the Anthropocene. *International Critical Thought*, 6(3), 393–421.
Foster, J. B., & Clark, B. (2016). Marx's Ecology and the Left. *Monthly Review, 68*(2), 1–25.
Foster, J. B., & Holleman, H. (2014). The theory of unequal ecological exchange. *Journal of Peasant Studies, 41*(2), 199–233.
Foster, J. B., & Magdoff, F. (1998). Liebig, Marx, and the depletion of soil fertility. *Monthly Review, 50*(3), 32–45.
Foster, J. B., Clark, B., & York, R. (2010). *The Ecological Rift*. New York: Monthly Review Press.
Frame, M. L. (2016). The Neoliberalization of (African) Nature as the Current Phase of Ecological Imperialism. *Capitalism Nature Socialism, 27*(1), 87–105.
Friedmann, H. (1978). World Market, State, and Family Farm. *Comparative Studies in Society and History, 20*(4), 545–586.
Galeano, E. (1973). *Opens Veins of Latin America*. New York: Monthly Review Press.
Galloway, J. H. (1989). *The Sugar Cane Industry*. Cambridge: Cambridge University Press.
Gill, B. (2016). Can the river speak? *Environment and Planning A, 48*(4), 699–717.
Goldman, M., & Schurman, R. A. (2000). Closing the 'Great Divide. *Annual Review of Sociology, 26*(1), 563–584.
Haraway, D. (1991). *Simians, Cyborgs, and Women*. New York: Routledge.
Haraway, D. (2008). *When Species Meet*. Minnesota: Univ. of Minnesota Press.
Haraway, D. (2016). Staying with the Trouble. In J. W. Moore (Ed.), *Anthropocene or Capitalocene?* (pp. 34–76). Oakland: PM Press.
Hartley, D. (2016). Anthropocene, Capitalocene and the problem of culture. In Anthropocene or Capitalocene?, ed. J.W. Moore, 154–65. Oakland: PM Press.
Harvey, D. (1974). Population, Resources, and the Ideology of Science. *Economic Geography, 50*(3), 256–277.
Harvey, D. (1982). *The Limits to Capital*. Oxford: Basil Blackwell.
Harvey, D. (1993). The Nature of Environment. In R. Miliband & L. Panitch (Eds.), *Socialist Register 1993* (pp. 1–51). London: Merlin.
Harvey, D. (1995). *Justice, Nature, and the Geography of Difference*. Cambridge: Blackwell.
Heynen, N., McCarthy, J., Prudham, S., & Robbins P. (Eds.). (2007). *Neoliberal Environments*. New York: Routledge.
Hopkins, T. K. (1982). World-systems analysis: Methodological issues. In T. K. Hopkins, I. Wallerstein, et al. (Eds.), *World-Systems Analysis* (pp. 145–158). Beverly Hills: Sage.
Hoppenbrouwers, P., & van Zanden, J. L. (Eds.). (2001). *Peasants into farmers?* Turnhout: Brepols.
Hulme, P. (1994). Tales of Distinction. In S. B. Schwartz (Ed.), *Implicit Understandings* (pp. 157–197). Cambridge: Cambridge University Press.
Jakes, A. (2016). Booms, Bugs, and Busts: Ecologies of Interest on Egypt's Commodity Frontier, 1882–1914. *Antipode*.
James, P. (2015). They have never been modern? *Arena Journal, 44*, 31–54.
Kicza, J. E. (1992). Patterns in Early Spanish Overseas Expansion. *William and Mary Quarterly, 49*(2), 229–253.
Kloppenburg, J. R. (1988). *First the Seed*. Cambridge: Cambridge University Press.
Kosík, K. (1976). *Dialectics of the Concrete*. Boston: D. Reidel.
Kuklick, H. (1991) *The savage within*. Cambridge University Press, 1991.
Lakatos, I. (1978). The methodology of scientific research programmes. Vol. I. Cambridge: Cambridge University Press.
Latour, B. (1993) We Have Never Been Modern. Cambridge, MA: Harvard University Press.
Leerssen, J. (1995). Wildness, Wilderness, and Ireland. *Journal of the History of Ideas, 56*(1), 25–39.
Lefebvre, H. (1991). *The Production of Space*. Oxford: Blackwell.
Levins, R., & Lewontin, R. (1985). *The Dialectical Biologist*. Cambridge: Harvard University Press.
Lewontin, R. C. (1991). Facts and the Factitious in Natural Sciences. *Critical Inquiry, 18*(1), 140–153.
Longo, S. B. (2012). Mediterranean rift. *Critical Sociology, 38*(3), 417–436.
Longo, S. B., & Clark, B. (2012). The Commodification of Bluefin Tuna. *Journal of Agrarian Change, 12*(2–3), 204–226.

Lukács, G. (1971). *History and Class Consciousness*. Cambridge: MIT Press.
Malm, A. (2016). *Fossil Capital*. London: Verso.
Mancus, P. (2007). Nitrogen Fertilizer Dependency and Its Contradictions. *Rural Sociology, 72*(2), 269–288.
Marley, B. J. (2016). The Coal Crisis in Appalachia. *Journal of Agrarian Change, 16*(2), 225–254.
Marx, K. (1959). *Economic and Philosophic Manuscripts of 1844*. Moscow: Progress Publishers.
Marx, K. (1967). *Capital. 3 vols*. New York: International Publishers.
Marx, K. (1973). *Grundrisse*. New York: Vintage.
Marx, K. (1977). Capital, Vol. I. New York: Vintage.
Marx, K. (1981). Capital, Vol. III. New York: Penguin.
Marx, K., & Engels, F. (1970). *The German Ideology*. New York: International Publishers.
McBrien, J. (2016). Accumulating Extinction. In J. W. Moore (Ed.), *Anthropocene or Capitalocene?* (pp. 116–137). Oakland: PM Press.
McMichael, P. (1990). Incorporating Comparison Within a World-Historical Perspective. *American Sociological Review, 55*(2), 385–97.
Meillassoux, C. (1981). *Maidens, meal and money*. Cambridge: Cambridge University Press.
Mellilo, E. D. (2015). *Strangers on Familiar Soil*. New Haven: Yale University Press.
Merchant, C. (1980). *The Death of Nature*. New York: Harper & Row.
Merchant, C. (1989). *Ecological Revolutions*. Chapel Hill: University of North Carolina Press.
Mills, C. W. (1959). *The Sociological Imagination*. Oxford: Oxford University Press.
Modest, W. (2012). We have always been modern. *Museum Anthropology, 35*(1), 85–96.
Moore, J. W. (2000a). Environmental Crises and the Metabolic Rift in World-Historical Perspective. *Organization & Environment, 13*(2), 123–157.
Moore, J. W. (2000b). Sugar and the Expansion of the Early Modern World-Economy. *Review, 23*(3), 409–433.
Moore, J. W. (2003a). *The Modern World-System* as Environmental History? *Theory & Society, 32*(3), 307–377.
Moore, J. W. (2003b). Nature and the Transition from Feudalism to Capitalism. *Review, 26*(2), 97–172.
Moore, J. W. (2003c). Capitalism as World-Ecology. *Organization & Environment, 16*(4), 431–458.
Moore, J. W. (2007). *Ecology and the Rise of Capitalism.* PhD dissertation, Department of Geography, University of California, Berkeley.
Moore, J. W. (2009). Madeira, Sugar, & the Conquest of Nature in the 'First' Sixteenth Century, Part I. *Review, 32*(4), 345–390.
Moore, J. W. (2010a). 'Amsterdam is Standing on Norway' Part I. *Journal of Agrarian Change, 10*(1), 35–71.
Moore, J. W. (2010b). 'Amsterdam is Standing on Norway' Part II. *Journal of Agrarian Change, 10*(2), 188–227.
Moore, J. W. (2010c). The End of the Road? Agricultural Revolutions in the Capitalist World-Ecology, 1450-2010. *Journal of Agrarian Change, 10*(3), 389–413.
Moore, J. W. (2010d). Madeira, Sugar, & the Conquest of Nature in the 'First' Sixteenth Century, Part II. *Review, 33*(1), 1–24.
Moore, J. W. (2010e). This Lofty Mountain of Silver Could Conquer the Whole World. *Journal of Philosophical Economics, 4*(1), 58–103.
Moore, J. W. (2011a). Transcending the Metabolic Rift. *Journal of Peasant Studies, 38*(1), 1–46.
Moore, J. W. (2011b). Ecology, Capital, and the Nature of Our Times. *Journal of World-Systems Analysis, 17*(1), 108–147.
Moore, J. W. (2014). The End of Cheap Nature, or: How I learned to Stop Worrying about 'the' Environment and Love the Crisis of Capitalism. In C. Suter & C. Chasde-Dunn (Eds.), *Structures of the World Political Economy and the Future of Global Conflict and Cooperation* (pp. 285–314). Berlin: LIT.
Moore, J. W. (2015a). *Capitalism in the Web of Life*. London: Verso.
Moore, J. W. (2015b). Cheap Food and Bad Climate. *Critical Historical Studies, 2*(1), 1–43.
Moore, J. W. (2016a). *Anthropocene or Capitalocene? Nature, History, and the Crisis of Capitalism*. Oakland: PM Press.
Moore, J. W. (2016b). The Rise of Cheap Nature. In J. W. Moore (Ed.), *Anthropocene or Capitalocene?* (pp. 78–115). Oakland: PM Press.
Moore, J. W. (2017a). The Capitalocene, Part I: On the nature and origins of our ecological crisis.*Journal of Peasant Studies, 44*(3), 594–630.
Moore, J.W. (2017b). The Capitalocene, Part II. *Journal of Peasant Studies*.
Mumford, L. (1934). *Technics & Civilization*. London: Routledge and Kegan Paul.
Murray, P. (1988). *Marx's Theory of Scientific Knowledge*. Atlantic Highlands: Humanities Press.

Nader, H. (2002). Desperate men, questionable acts. *Sixteenth Century Journal, 33*(2), 401–422.
Niblett, M., & Campbell, C. (Eds.). (2016). *The Caribbean*. Liverpool: Liverpool University Press.
Ohlmeyer, J. (2016). Conquest, Civilization, Colonization. In R. Bourke & I. McBride (Eds.), *The Princeton History of Modern Ireland* (pp. 21–47). Princeton: Princeton University Press.
Ollman, B. (2003). *Dance of the Dialectic*. Urbana: University of Illinois Press.
Oloff, K. (2016). Zombies, Gender and World-Ecology. In M. Niblett & C. Campbell (Eds.), *The Caribbean*. Liverpool: Liverpool University Press.
Overton, M. (1996). *Agricultural Revolution in England*. Cambridge: Cambridge University Press.
Oxford English Dictionary. (2016). Society. In *The Oxford English Dictionary*, www.oed.com, accessed 10 July 2016.
Parenti, C. (2015). The Environment-Making State. *Antipode, 47*(4), 829–848.
Patel, P. (2013). The Long Green Revolution. *Journal of Peasant Studies, 40*(1), 1–63.
Patel, R., and Moore, J. (2017). A History of the World in Seven Cheap Things. Berkeley, CA: University of California Press.
Patterson, O. (1982). *Slavery and Social Death*. Cambridge: Harvard Univ. Press.
Peluso, N., & Watts, M. (Eds.). (2001). *Violent Environments*. Ithaca: Cornell University Press.
Peet, R., P. Robbins, and M. Watts, eds. (2011). *Global Political Ecology*. New York: Routledge.
Plumwood, V. (1993). *Feminism and the Mastery of Nature*. New York: Routledge.
Poly, J., & Bournazel, E. (1997). *The Feudal Transformation, 900–1(200)*. New York: Holmes & Meier.
Pomeranz, K. (2000). *The Great Divergence*. Princeton: Princeton University Press.
Post, C. (2011). *The American Road to Capitalism*. Leiden: Brill.
Pred, A. (2006). No title, faculty biography page, http://geog.berkeley.edu/PeopleHistory/faculty/A_Pred.html, accessed 23 April 2015.
Rai, M. (1993). Columbus in Ireland. *Race & Class, 34*(4), 25–34.
Raworth, K. (2014). Must the Anthropocene be a Manthropocene? *The Guardian* (October 20).
Sayer, D. (1987). *The Violence of Abstraction*. Oxford: Blackwell.
Schiebinger, L. L., & Swan, C. (Eds.). (2005). *Colonial Botany*. Philadelphia: University of Pennsylvania Press.
Schneider, M., & McMichael, P. (2010). Deepening, and Repairing, the Metabolic Rift. *Journal of Peasant Studies, 37*(3), 461–484.
Smith, N. (1984). *Uneven Development*. Oxford: Basil Blackwell.
Sobel, R. (1965). *The Big Board*. New York: Free Press.
Sohn-Rethel, A. (1978). *Intellectual and Manual Labour*. Atlantic Highlands: Humanities Press.
Stavig, W. (2000). Ambiguous Visions. *Hispanic American Historical Review, 80*(1), 77–111.
Sued-Badillo, J. (1992). Christopher Columbus and the enslavement of the Amerindians in the Caribbean. *Monthly Review, 44*(3), 71–103.
Taylor, G. R. (1951). *The transportation revolution, 1815–1860*. New York: Holt, Rinehart and Winston.
Taylor, P. J. (1999). *Modernities*. Minneapolis: University of Minnesota Press.
Taylor, M. (2015). *The Political Ecology of Climate Change Adaptation*. New York: Routledge.
Thomas, B. (1993). *The Industrial Revolution and the Atlantic Economy*. New York: Routledge.
Thompson, F. M. L. (1966). The social distribution of landed property in England since the sixteenth century. *Economic History Review, 19*(3), 505–517.
Tilly, C. (1984). *Big structures, large processes, huge comparisons*. New York: Russell Sage.
Tomich, D. (2004). *Through the Prism of Slavery*. Lanham: Rowman and Littlefield.
Toscano, A. (2016). The World Is Already without Us. *Social Text, 34*(2), 109–124.
von Werlhof, C. (1988). On the concept of nature and society in capitalism. In M. Mies et al. (Eds.), *Women: The Last Colony* (pp. 96–112). London: Zed.
Wackernagel, M., & Rees, W. (1996). *Our Ecological Footprint*. Gabriola Island: New Society Publishers.
Walker, R. A. (2004). *The Conquest of Bread*. New York: New Press.
Walker, R.A. (2017). Value and Nature. *Capitalism Nature Socialism, 28*(1), 53–61.
Wallace, R. (2016). *Big Farms Make Big Flu*. New York: Monthly Review Press.
Wallerstein, I. (1974). *The Modern World-System I*. New York: Academic Press.
Warf, B., & Arias, S. (Eds.). (2008). *The spatial turn*. New York: Routledge.
Watts, M. J. (1983). *Silent Violence*. Berkeley: University of California Press.
Watts, M. J. (2005). Nature: Culture. In P. Cloke & R. Johnston (Eds.), *Spaces of Geographical Thought* (pp. 142–174). London: Sage.
Weis, T. (2013). *The Ecological Hoofprint*. London: Zed.

Williams, R. (1980). Problems in Culture and Materialism. London: Verso.
Williams, R. (1983). *Keywords*. Oxford: Oxford University Press.
Wood, A. (2007). *The 1549 rebellions and the making of early modern England*. Cambridge: Cambridge University Press.
Worster, D. (1990). Transformations of the Earth: Toward an Agroecological Perspective in History. *Journal of American History, 76*(4), 1087–1106.
York, R. (2007). Demographic trends and energy consumption in European Union Nations, 1960–2025. *Social Science Research, 36*(3), 855–872.
York, R. (2010). Metabolic Rift. In C.J. Cleveland, ed., *Encyclopedia of the Earth*, http://www.eoearth.org/view/article/154577/, accessed 8 March, 2014.
York, R., & Clark, B. (2010a). Nothing New Under the Sun? *Review, 33*(2/3), 203–224.
York, R., & Clark, B. (2010b). Critical Materialism. *Sociological Inquiry, 80*(3), 475–499.
Young, R. M. (1979). Science is a Labor Process. *Science for the People, 43-44*, 31–37.

Jason W. Moore is a historical geographer and world historian at Binghamton University, where he is Associate Professor of Sociology and Research Fellow at the Fernand Braudel Center. He is author of *Capitalism in the Web of Life* (Verso 2015) and editor of *Anthropocene or Capitalocene? Nature, History, and the Crisis of Capitalism* (PM Press 2016). He writes frequently on the history of capitalism, environmental history, and social theory. His research has been recognized with the Distinguished Scholarship Award of the Section on the Political Economy of the World-System, American Sociological Association (2002 and 2015); the Alice Hamilton Prize in environmental history (2003); the Braverman Award in labor studies (1999); and the Bernstein and Byres Prize in agrarian studies (2011). Moore's latest book is *A History of the World in Seven Cheap Things* (2017), with Raj Patel, and he is presently completing *Ecology and the Rise of Capitalism* – both with the University of California Press. He is coordinator of the World-Ecology Research Network.